Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXIX. NEW YORK, SATURDAY, FEBRUARY 1, 1902. No. 5.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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ELECTRICAL WORLD AND ENGINEER.

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The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - - 6.00
Single Copies, - .10

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, FEBRUARY 1, 1902.

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THE EXPORT RECORD OF 1901.

It has already been noted in these pages that the exports from this country for 1901 were not quite so high as those of 1900, apparently, but the decline of $12,000,000 is more than set off by the fact that the amount of $30,000,000 to Porto Rico and Hawaii disappears from export totals. Besides, prices were generally somewhat weaker and lower last year, and the only fair inference is that in quantity American products went abroad as largely as before, possibly in greater bulk than ever. But it would be more satisfactory, so far as manufacturers are concerned, if the falling off in iron and steel had been less than $27,000,000, while the decline in copper of $23,000,000 was due to the unfortunate decline in European requirements. After all, the total falling off in American exports to Europe, where depression was most felt, was only $17,000,000.

Whether the American tide of prosperity is at its full or not, is a moot question, but there are many signs of recovery in Europe, and no reason exists for doubting that a large export trade will be done this year, while importations are also increasing as they must in any normal trade situation. Our iron and steel industries are, in fact, so busy for the year, larger importations in that line may even be expected, but for the miscellaneous goods of American make already becoming known abroad, the market exists that does but need cultivation and attention to become much larger than it is to-day.

LARGER NIAGARA GENERATORS.

The interesting news which we publish this week as to the new generators for the Canadian development of Niagara power is of great importance from whatever point of view it be regarded. These colossi of 10,000 hp are far and away the biggest of their kind, and are virtually about double the size of any machines in New York City, as well as twice as big as the previous units at the Falls. This is a great jump to make, and must, of course, be attended by an equivalent jump in the construction of turbines. Our pleasure at recording the award of this Canadian contract to an American concern is tempered by the belief that the turbines will, as heretofore, be of Swiss design, although the heavier castings may be made on this side. The Swiss engineers and turbine builders are heartily to be congratulated on the skill and boldness that constitutes them leaders in this engineering field, and makes them fitting companions to Mr. C. E. L. Brown.

One naturally wonders what use will be made of this 30,000 hp of current. Of course, some of it can be brought across to the American side, but the plant there is already in process of enlargement and duplication. We shall not be at all surprised to learn that Toronto is the goal. Transmission to that point has already been discussed, and it is an easy 80 miles, with no natural, physical difficulties intervening. The management of the Niagara plant were recently in California, and came back very favorably impressed with the long-distance work done there, 80 miles being an early figure in Pacific Coast power enterprises. Such a Toronto transmission will be but one of many under the British flag, for there is heavy work doing in India, and in our present issue note is made of a serious plan for operating hundreds of miles of South African railway from a distant waterfall.

INTERNATIONAL INDUSTRIAL COURTESY.

In commenting upon the visit last summer to Germany of the British Institution of Electrical Engineers, our English contemporary, the *Electrician*, pays a tribute concerning the cordial spirit

in which the Institution party was everywhere welcomed. To whatever extent, it says, "Made in England" may be better—or worse, we may add—than "Made in Germany," there is no doubt that the English electrical engineers were shown samples of the best of everything, and that they were afforded opportunities of intercourse and exchange of ideas with the most distinguished of their German fellow-workers. We are glad to note that in at least one European country such a spirit of professional and industrial courtesy prevails. It has always been the custom of electrical manufacturers in this country to offer every facility to the properly introduced foreigner to inspect their works, and the grateful surprise in consequence, which we have so frequently heard expressed by such visitors, had led us to believe that the practice was a peculiarly American one, a result of the exuberant national amiability concerning which Herbert Spencer expressed some misgivings. In point of fact, however, little or no danger is incurred—at least in this country—by an indulgence in such courtesy. As a foreign manufacturer sadly remarked when asked if he had derived any benefit from his visit among American electrical works, the success of American manufacturing is so largely due to a combination of restless activity, workshop organization, skilled and ambitious labor and continuous specialization of tools, that while one may learn much by a study of American manufacturing methods, but little or none of the knowledge has yet been applied abroad.

THE WORLD'S LONGEST POWER TRANSMISSIONS.

Dr. Perrine's important lecture before the New York Electrical Society on the great power transmission plants of the Pacific Coast came almost like a revelation to many of the engineers who heard him. Plant after plant has been described in the technical press, but somehow isolated descriptions do not sink into the consciousness like a carefully collated discussion of the entire group. We in the East have but an imperfect idea of Californian conditions, and many a striking transmission plant in that region has been quietly slipped into service almost unknown even to the engineering public. Perhaps one reason for this large measure of quiet success is that our coast friends have felt the press of necessity in the matter of cheap power far more than those who dwell a thousand miles nearer the coal fields, and have gone resolutely to work to improve conditions. Consequently, with everybody working for the common good nobody raises an eyebrow at the installation of a 25 or 35-mile transmission of 15,000 or 20,000 volts—it takes two or three times both figures to really awaken interest. Here in the East even a very moderate transmission stirs up opposition with a sharp stick.

California, on the other hand, is the birthplace of real long-distance power transmission on this continent. Pomona saw the first demonstration of high-line voltage, Bodie the first serious power transmission, Redlands the beginning of polyphase transmission and distribution. Niagara, magnificent as it really is, deservedly advertised as no other transmission plant ever has been, has hitherto made less impression upon the art than these, and has not even yet developed what could fairly be called a long or high-voltage line. The vast service of the Western plants has been this, that their promoters and engineers have dared, and, daring, have accomplished, what others have grown faint-hearted at sight of. The result is that to-day power transmission for more than 200 miles at 40,000 volts is an established commercial fact. It is only 10 years ago this month that the Pomona plant went into service, but 60,000 volts is in immediate sight, its feasibility having already been demonstrated. If to-day one should lay before any engineer personally familiar with the California work, a project for sending power from Niagara to Chicago at 75,000 volts, he would never wince. This great extension of the domain of electrical power transmission has been in two allied but yet distinct branches. First has been the fearless treatment of voltages much higher than custom had hitherto sanctioned. Ferranti, abroad, was seemingly the first man who foresaw the trend of alternating current working, but his experiments, involving the even now desperate resort of high voltage underground, were under such unfavorable conditions that they checked rather than encouraged progress. The Frankfort-Lauffen experiments inspired wonder rather than confidence, and before they had led to any important results, the combination of a persistent California parson and a level-headed American engineer had turned the trick and a 28-mile 10,000-volt line was an accomplished fact.

But high-voltage involves more difficulties than mere insulation strength of materials. It implies as the lines grow longer a serious increase of static effects due to condenser action, and there were plenty of wiseacres, especially of the irreconcilable and fanatical wing of the sect of continuous-currentites, and who solemnly put their noses down to their equations and showed to the satisfaction of any reasonable school-man that long-distance transmission would infallibly prove a disastrous failure. But strange to say there were some practical factors in the matter which they had forgotten, and the lines have kept stretching out to confound them and their fine drawn theories. Every dreaded bugaboo—even resonance—has proved on closer acquaintance to be a fantastic, harmless spook instead of a serious obstacle to further progress.

The two great systems which Dr. Perrine described to the Society with particular care are by all odds the greatest achievements of American engineers in the art of electrical power transmission. Not only are they much longer than anything hitherto attempted, but the Standard Company at least is to operate at a voltage half again as high as any hitherto put in commercial use. Forty thousand volts, the pressure used by the Bay Counties Company at the present time, has already been demonstrated to be entirely feasible. Not only has the problem of line insulation at this pressure been pretty thoroughly worked out, but the voltage in question has been experimentally shown to be below the point at which unusual difficulties are especially to be looked for. But 60,000 volts is nearer a possible danger line, and it is worth noting that it was selected for this work by Dr. Perrine, who was Prince Poniatowski's consulting engineer, some time before even 40,000 volts had been established as a safe working voltage. The later work, and recent experiments at voltages even up to and above 100,000, have in our opinion fully justified Dr. Perrine's courageous choice as well within the limits of a safe practice. We shall be greatly surprised if this tremendous voltage gives any serious trouble in commercial use, and we venture to predict that the transmission into San Francisco will be, upon the whole, as reliable as if it were of a tenth part the length and voltage. With modern methods of construction and insulation the line has ceased to be the weak point in a transmission system. If long it must be kept under thorough inspection, but in a great power transmission system the minor distribution circuits are ten times more likely to cause serious trouble than the main line, because in them there is less obvious need of extreme care. The extreme present range of transmission on these great California systems is 218 miles, over part of the Standard lines from the Colgate power house of the Bay Counties Company, but its success will ensure still further extensions of commercial range. It is worth noting that both these great plants are worked at 60 cycles, showing the entire futility of the extraordinary claims in behalf of very low frequency put forward a few years since. If for any purpose very low frequency is convenient or desirable it is assuredly sound policy to employ it if one wants it, but for all general purposes it is not a matter of necessity or importance even over circuits more than 200 miles long. Dr. Perrine is to be

greatly congratulated not only on the admirable and striking manner in which he has described the splendid work accomplished on the Coast, but for his own personal part in these most distinguished achievements—which has not been small.

ENERGY, MOTOR CAPACITY AND SCHEDULE SPEED IN ELECTRICALLY PROPELLED CARS.

The meeting of the American Institute of Electrical Engineers last week was devoted to electric traction in general, and, in particular, to a paper by Dr. Hutchinson. The paper was prefaced by an able introduction from the President. The paper was a theoretical disquisition upon the relations between the power and motor capacity to schedule speed, based on a number of assumptions. It is clear that so many variables enter into the question as to what should be the size of the motors on a car or train, for a given schedule speed over a given profile and distance of track, that unless some definite and simple assumptions are made, there is very little chance of obtaining a formula which will be simple enough for practical use. The same complexity makes the estimation of the watt-hours per car-mile equally hopeless, unless similar assumptions are made. In a problem of this kind, leading to a definite mathematical solution, after the question of accurate algebraic or numerical work has been set aside as settled, the question arises as to how far the simplifying assumptions affect the case, and the amount of deviation in the computed results from those which practice must develop. Thus in the paper under consideration, the train resistance was assumed constant at 18.2 lbs. per ton of moving mass—or not far from 1 per cent. Now, in reality, the train resistance increases in a somewhat complex manner with the speed, owing to air resistance. A formula which employed a simple uniform train resistance would be, therefore, more likely to give reliable results at low speeds than at high speeds.

As the running distances of electric traction increase, the effect of the rate of acceleration becomes of less importance, owing to the relatively small amount of time occupied in accelerating, compared with the total time of each run. But where, as in street car, or city elevated, railroad practice, the runs are short, and a fairly high schedule speed is demanded, the importance of the accelerating conditions is magnified. Having given a length of straight level track between two stopping places, and a uniform braking force or retardation in the brakes, it is clear that the mechanical work performed by the motors on the car will be expended partly on the train resistance, and partly in the brakes. If the train resistance is assumed to be the same at all speeds within the practical range, then the work done against train resistance will be constant, and the only variable quantity will be the work absorbed by the brakes. This would be made to vanish entirely if the train resistance were allowed just to stop the car at the end of the run without having to apply the brakes; so that where the schedule speed was sufficiently low to permit running without brakes, or with no appreciable expenditure of energy in brakes, the least motor output would be attained with any accelerations which just reached the velocity sufficient to bring the car to rest at the distant station. This would entail so slow a retardation, and so moderate a schedule speed, that it would never suit the traveling public, and, in fact, a relatively considerable proportion of the total work done by the motors is usually absorbed and wasted in the brakes in urban street railway service.

The greatest economy of mechanical power, therefore, which a given rapid schedule imposes, is that which makes the velocity near the end of the run least, at the moment when brakes have to be applied, because the loss of energy in brakes is known to be nearly proportional to the square of the speed at which the braking commences. Consequently, the conditions of acceleration for minimum mechanical power are such as give, in the schedule time, the least braking velocity. This condition requires sudden acceleration and prolonged coasting. If, regardless of the feelings of the passengers, the car could be started instantaneously, as though shot out of a gun, and then allowed to coast for the rest of the journey, the speed at the time for applying the brakes would be a minimum. In other words, according to the theory of cars running on a short schedule between frequent stops, the mechanical energy exerted by the motors is a minimum, when the cars are propelled by a momentary impulse which communicates the energy necessary for doing work against the train resistance and against the brakes, during such time as the brakes have to be applied in order to fill the schedule time. As this purely hypothetical and impossible impulsive starting is departed from, and the car accelerates more leisurely by spending more time in getting up to speed, the velocity attained in the middle of the run must be greater to make up for the time lost in starting, and the velocity at the time when the brakes must be applied must be greater, representing a reduced mechanical efficiency. Consequently, on rapid urban service, high mechanical efficiency demands rapid acceleration.

On the other hand, rapid acceleration means either an increased weight of motors, to give the necessary initial torque, or else it means a more wasteful acceleration; since at low speeds powerful torque is only obtained with increased starting current, larger rheostats and reduced electrical efficiency. After a certain acceleration has been attained, the tendency to waste electrical power in the starting rheostats more than offsets the saving in the mechanical power wasted by brakes. To some extent, therefore, the conditions of maximum mechanical efficiency are opposed to the conditions of maximum electrical efficiency, and a compromise has to be effected between them, thus limiting the rapidity of acceleration, even without regarding the comfort of the passengers and the overload current capacity of the system. Moreover, a comparatively small variation in the constants assumed is apt to make a relatively considerable variation in the results deduced under such conflicting tendencies.

The conclusion pointed out in Dr. Hutchinson's paper was that the acceleration giving the least motor weight per ton is the most economical. Also that, in general, the energy per car-mile is least at comparatively low accelerations. This general conclusion was disputed in the discussion, it being held that economy as well as swiftness of service demands a reasonably rapid acceleration. It would seem that the range of variation in the constants assumed by the paper might considerably change the conclusion in different cases. Any such paper must be regarded as a study in pure railway kinematics, as distinguished from a general exposition of railway practice, owing to the great complexity and diversity of the active factors.

Mr. Storer, in discussing the paper, brought out the interesting fact that, on the average, the inertia of the rotating car wheels and rotating motor armatures virtually added 10 per cent to the weight of the car by their gyrostatic momentum, so that a car weighing, say, 20 tons, has its momentum increased by the gyrostatic effect of the rotating parts, to approximately that of a car having no rotating parts, but a mass of 22 tons. Also, that in the day's work, this additional virtual momentum frequently represented a considerable increase in the energy wasted in brakes. During acceleration the retardation due to gyrostatic momentum is overcome and paid for by the current supplied, but during coasting and braking, the momentum plays the same effect as extra mass. We regret that lack of space prevents the presentation in full of Dr. Hutchinson's paper, and of the extended discussion which followed its reading. The whole forms a most valuable and timely contribution to the literature of electric traction, and those interested will do well to obtain a copy, when published, of the *Transactions* containing the same.

Discussing the New York Tunnel Problem.

Following up the interesting discussion started by Mr. Westinghouse as to the dangers arising from the use of combustible cars in electric railway work, further letters have appeared in the daily newspapers, in addition to those we have already quoted, the *New York Times* being the chief medium for their publication. Mr. L. B. Stillwell has an excellent treatment of the subject, and says:

The public demands higher and still higher speeds, and this demand must be met. It should be met, however, conservatively and with due regard to every reasonable precaution that can insure the safety of the traveling public. If speeds are increased, brakes must be made correspondingly more powerful. I have little sympathy with that kind of electrical railway engineering which busies itself exclusively with the construction of theoretical speed curves, ignoring practical questions of railway operation, the importance of which has been established by long years of experience, but I cannot agree with Mr. Westinghouse that in case of a wreck the risk of fire caused by resulting short circuits is at all comparable with the risk of fire when a steam locomotive, carrying in its firebox from 1500 to 2000 lbs. of incandescent coals, plows its way through a car. If the current to each car be supplied through a proper automatic circuit-opening device there is every reason to expect that the current will be cut off before a fire is started. If, in addition to this, as for example in the case of the Manhattan Railway Company, the third rail is divided into sections, each of which is supplied through an automatic circuit breaker located in the sub-station, it would seem that assurance is made doubly sure. Theoretically, of course, it is not impossible that both circuit breakers should fail to operate and that a fire might result, but, in my opinion, the chances of such an occurrence are very remote.

Mr. Ray D. Lillibridge holds that existing electrical apparatus and methods are at least superior to the utmost that steam can do, and remarks:

As to the bogy of short circuits from accidents and resultant conflagration, I have in mind now three accidents of derailment and one of a rear-end collision, all on elevated structures, utilizing the third rail, each of which resulted as such an accident is certain to result, Mr. Westinghouse's assertions to the contrary notwithstanding, in the opening of the circuit breaker at the power house, rendering that section of the road electrically dead. If time allowed, I could point out where one of the companies bearing Mr. Westinghouse's name has advertised to supply precisely such a device, eulogizing its absolute positiveness. Mr. Westinghouse would do well to take a ride through the section of the Fourth Avenue tunnel below Forty-second Street, where electric cars run at high speeds during rush hours on 20 seconds' headway. All the advantages of a properly equipped tunnel are here manifest. I know of no accidents having occurred in this piece of ideal subway. I beg to invite even those who know naught of the technicalities dealt in to contemplate the environment of an electrically driven, lighted and heated train in an electrically lighted tunnel, with atmosphere fresh and breathable, and then compare with this combination a train drawn by a steam locomotive, heated by steam, lighted by gas, in a tunnel filled with noxious lurid fumes.

Electrical Engineers of the Day—XXXI.

A. S. HIBBARD.

Mr. Angus S. Hibbard is a native of Wisconsin, having been born in Milwaukee in 1860. He entered Racine College, but ill health forced him to leave college before the completion of his course. Upon returning to Milwaukee he turned his attention to the business of railroads, but gave up that vocation at the end of a year to accept the position of secretary to the general superintendent of the Northwestern Telegraph Company. Here an opportunity presented itself for the study of the telephone, which was then beginning to interest men of affairs. With characteristic enthusiasm Mr. Hibbard took up telephony, and with such signal success that he was made superintendent of the Wisconsin Telephone Company in 1881.

Early in his career with the Wisconsin Telephone Company he earnestly advocated the extension of toll lines, and his work in this direction attracted attention all over the world. He was one of the first to demonstrate the commercial practicability of transmitting speech over long distances. Naturally he was the man to be selected for the first general superintendent of the American Telephone & Telegraph Company. This position brought him to New York City in 1886, where he resided for seven years. These seven years were destined to be prolific in all things pertaining to the telephone. He was one of the first and most earnest advocates of metallic circuits, and expended much energy in securing their introduction.

During his connection with the American Telephone & Telegraph Company, commonly known as the Long-Distance Company, long-distance lines were extended very generally throughout the East and as far west as Chicago. Mr. Hibbard was an active factor in guiding these extensions, inaugurating new operating and maintenance methods, and creating new apparatus to meet the conditions introduced by the construction of long circuits connecting widely separated cities.

In the year 1893 Mr. Hibbard left New York and became the general manager of the Chicago Telephone Company. During his connection with that company the business both, urban and suburban, has been greatly extended, and the system changed from local battery to common battery, with its consequent improvement in service.

Mr. Hibbard has been not only a brilliant executive officer, but he has also been closely affiliated with the engineering side of telephony, and there is hardly a branch of the business upon which he has not left an impression. He has been a member of the various technical committees which have at various times been formed, for the purpose of standardizing methods and equipment. Very many of his improvements have been covered by letters patent, and an idea of their scope may be formed when it is stated that they comprise protective

devices, distributing methods, selective signaling, switchboard designs, operating devices, test circuits, etc. His devices have been used not only in the United States, but also in many foreign countries.

Aside from business, Mr. Hibbard has had many interests, and his friends know him to be a jolly good fellow, and an all-around man. Not endowed by nature with a robust constitution, Mr. Hibbard has sought health as well as recreation in out-doors sports. In the early days of the bicycle he was an enthusiast, and was one of the best amateur riders in Wisconsin. Music is another field in which Mr. Hibbard excels, he having composed several operettas of merit. After the presentation of his most successful operetta, Mr. Hibbard was urged to adopt musical composition and score writing as a profession, and go into the work seriously. Though the inducements offered were of the most congenial nature, his early training in business methods prevailed and music continued as a recreation. For many years he has taken an active part in oratorio work, and is president of one of the largest oratorio societies in the West. With the advent of golf in this country, Mr. Hibbard became a golfer in the most enthusiastic sense, and he has recently built a handsome summer residence within easy reach of the Glenview Golf and Polo Club, Chicago's most popular suburban club. While chasing the elusive golf ball, in an endeavor to outwit Bogy, Mr. Hibbard has been inspired by the muses. His friends were pleasantly surprised to receive recently a copy of "Golfing Songs," which in the spirit of good fellowship, the author dedicated to the members of the Glenview Club.

The Waterside Station of the New York Edison Company—IV. (Concluded.)

Storage Batteries, Boosters and Compensators.

STORAGE BATTERIES are installed at nearly all the stations from which current is distributed, and they perform at least three important functions. First, they insure continuity of the service; second, they smooth out the irregularities of the local demand; third, they assist in the regulation of the system.

The standard battery used contains 150 cells, 75 between the neutral and each outside wire. Each cell has a capacity of 2000 ampere-hours at a one-hour rate, 3000 ampere-hours at a three-hour rate, 4000 ampere-hours at a ten-hour rate.

Fig. 45 is a view of the battery room and a portion of the end cell mechanism in use at the Eighty-fourth Street station, which is characteristic of that at the other stations.

Connections from 20 cells at each end of the battery are brought out to the positive and negative end cell switches, which are operated by a small motor controlled from the main switchboard. Each battery has two end-cell switches on each side of the system, permitting simultaneous connection to two buses. The batteries are charged by means of a booster set, consisting of a 110-hp, 240-volt motor operating at 750 r. p. m., and two 40-kw, 50-volt generators, mounted on the same shaft.

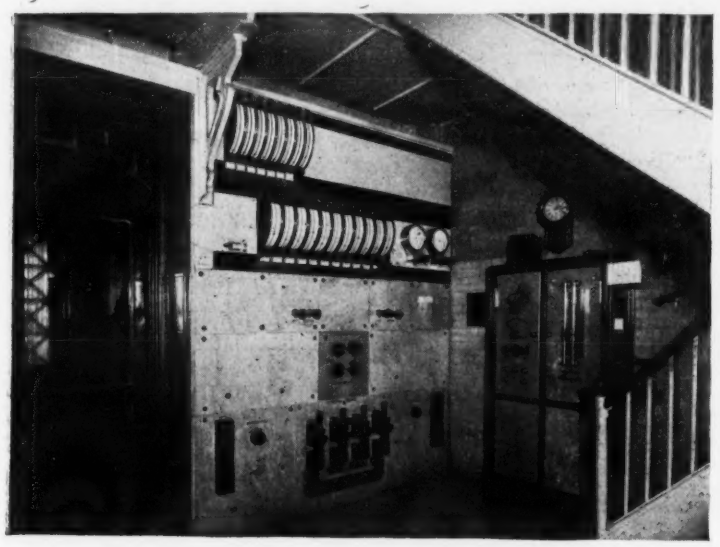


FIG. 45.—LOW-TENSION FEED PANELS AND SWITCHBOARD, EIGHTY-THIRD STREET SUB-STATION.

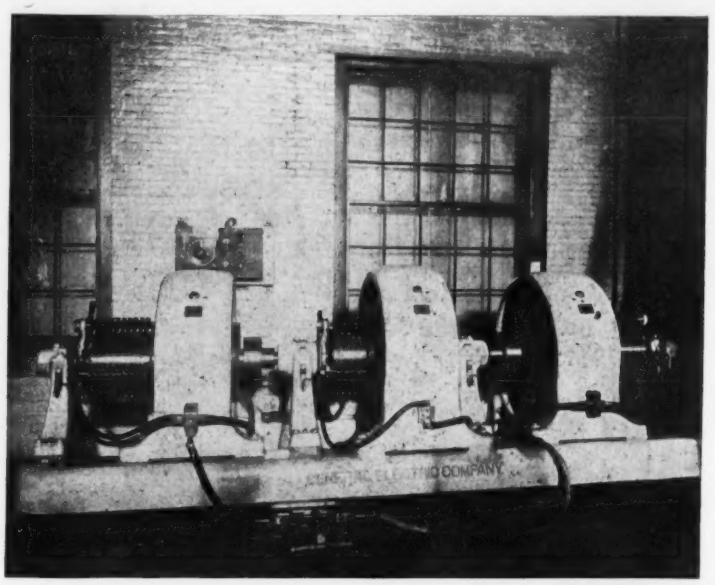


FIG. 46.—BATTERY BOOSTER.

The company's policy of requiring lighting installations of a capacity of more than 5 amperes to be connected on the three-wire system has created an almost perfectly balanced load on both sides of the system. In addition to the battery which assists in maintaining the balance each rotary sub-station is provided with a small compensator set consisting of two 125-volt dynamos, rigidly coupled together and connected in series across the system with the middle point connected to the neutral. When there is a perfect balance both dynamos run as motors, but in case the system is unbalanced one dynamo becomes a generator supplying current to the weaker side.

LOW-TENSION FEEDER SWITCHBOARD.

The low-tension feeder panels are grouped into a positive and negative board, each of which is provided with three sets of bus-bars mounted on the back of the panels, which are built up in sections on the Van Vleck edgewise system. (Fig. 47.) Each panel has two switches, each with a capacity of 1500 amperes connecting with two different busses, and above the switches are mounted a Weston edgewise ammeter and a voltmeter. Pressure wires of each feeder are also connected to a suitable sliding contact switchboard connected to a standard voltmeter.

The feeder neutrals are not brought to the operating switchboard, but are connected with the battery and compensator neutrals to the neutral bus located in the feeder vault of the station. The neutral bus is efficiently grounded at each station and each feeder has its neutral terminal grounded at the feeder end box.

LOW-TENSION FEEDERS AND MAINS.

The feeders and mains are all underground, and are connected in a continuous network in the Edison three-wire system with 2 by 120 volts at the customer's service. In the early underground construction the company used three conductor Edison tubes exclusively, for its feeders and mains, but for some years paper-insulated cables have been used for feeders, and more recently for mains also. For feeders the company has adopted a lead-covered paper-insulated two-conductor concentric cable with a copper section of 1,000,000 cm for each conductor, and provided with six pressure wires (Fig. 48). These cables are designed for a maximum working pressure of 750 volts direct current, and have 5/32-inch paper insulation and a 9/64-inch lead jacket. The common neutral system is used as a general neutral serving for all feeders and connecting with the neutral main at ever block.

The cable mains shown in Fig. 48 are either 350,000 or 200,000 cm. single-conductor, paper-insulated, lead-covered cables. They are designed for a maximum working pressure of 750 volts direct current, with 4/32-inch insulation and 4/32-inch lead jacket.

The accompanying map, printed as a supplement to this issue of ELECTRICAL WORLD AND ENGINEER, shows the extension of the Edison system on Manhattan Island, many of the streets having mains on both sides. The distributing system of feeders and mains represents a total length of nearly 350 miles.

The map shows also the 60-cycle alternating-current circuits in the Bronx district served by the Rider Avenue generating section.

PRESENT STATION EQUIPMENT.

In Fig. 49 is shown the load diagram of the output from the low-tension direct-current service for all stations of the New York Edison Company on Manhattan Island on the day of maximum load, Dec. 23, 1901. The maximum load reached was more than 35,000 kw, exclusive of the alternating-current, 60-cycle service and the direct-

current series arc lamp service of the New York Edison Company. This load was carried by the existing low-tension steam plants, by rotary converters and by the storage batteries distributed among the different stations.

Beginning at the lower end of Manhattan Island in the Bowling Green Building is an annex with two 400-kw rotary converters and a storage battery used for the peak load and local distributing purposes. At Gold Street, near Fulton, is a 1650-hp steam station, equipped also at present with a 500-kw rotary and a storage battery. At Duane Street is the largest station of the company, erected in 1890 and equipped with three 2500-hp, two 1250-hp and three 600-hp engines, all of the multiple expansion type, driving direct-connected dynamos for a 240-volt, three-wire system. The engines are of the Southwark and of the Dickson make, and the boilers Babcock & Wilcox. This station has also a rotary converter equipment consisting of three 1000-kw units. On Elm Street, near Spring, is a rotary sub-station, with a capacity at present of 2000 kw and a storage battery. At Vandam Street is a 1500-hp steam station, with one 1000-kw rotary converter. At Horatio Street is a sub-station with one 500-kw rotary converter and a storage battery, and at Twelfth Street is a steam

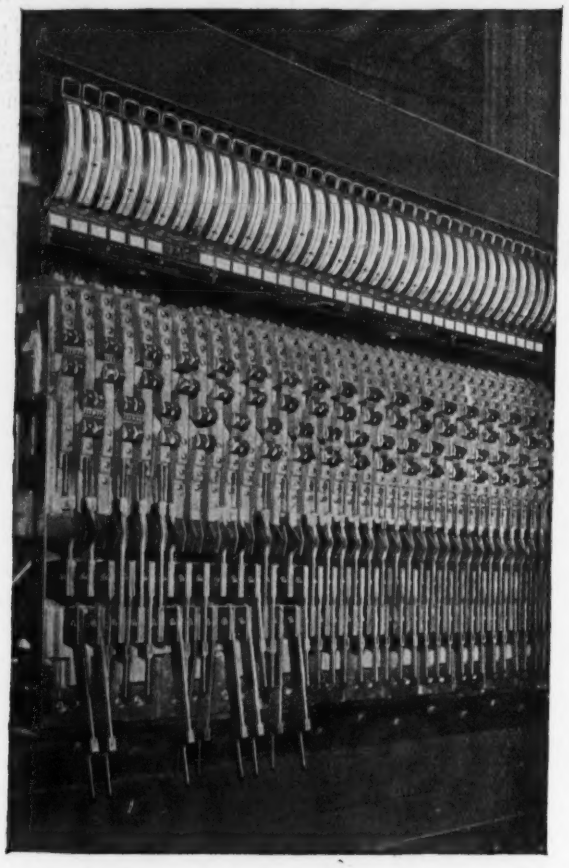


FIG. 47.—LOW-TENSION FEEDER BOARD, DUANE STREET.

station containing two 1250-hp compound condensing engines and one 500-hp single-cylinder McIntosh & Seymour engine, two storage batteries and 2500 kw capacity in rotary converters. The Twenty-sixth Street station contains three 1250-hp Southwark, three 600-hp Dickson and two 250-hp Armington & Sims engines, and in the adjoining annex four 1000-kw rotary converters. At Thirty-ninth Street are six 250-hp engines, 3000 kw in rotaries and a storage battery. At Fifty-third Street 1000 hp in engine capacity, 2500 kw of rotaries and two storage batteries. The annex stations in the upper part of the city are as follows: East Eighty-third Street, three 500-kw rotary converters and storage battery; West Eighty-fourth Street, two 500-kw rotary converters and storage battery; East 121st Street, three 500-kw rotary converters and storage battery; West 124th Street, one 500-kw rotary converter and storage battery. A steam station in East Eightieth Street of 3500 hp, with two-phase alternating-current and arc-light machinery, completes the equipment. The storage batteries in all of the plants mentioned, except at Fifty-third Street and Twelfth Street, where the capacity is double the others, are equal to an output of 6000 ampere-hours at 135 volts at a three-hour rate of discharge. They were furnished by the Electric Storage Battery Company.

COMPANY'S INSTALLATION.

The electrical installation supplied from the New York Edison Company system on Manhattan Island, Dec., 31, 1901, is as follows:

Incandescent lamps	970,899
Arc lamps	13,140
Horse-power motors	50,634
Total 16-cp equivalent	1,867,442

Each arc lamp is figured as equivalent to 10 16-cp incandescent

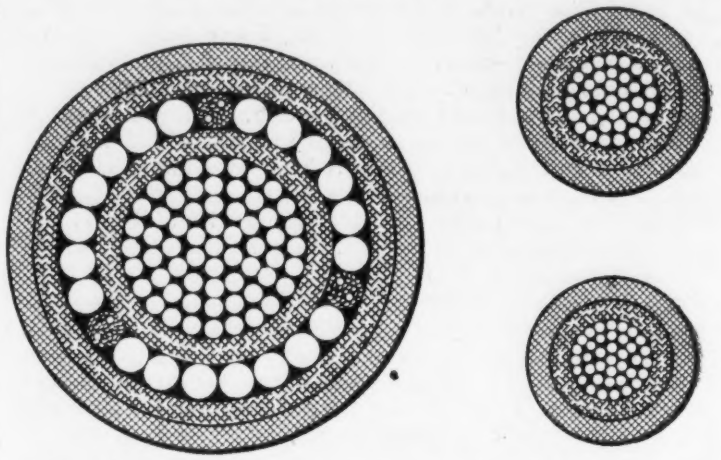


FIG. 48.—TWO-CONDUCTOR PAPER-INSULATED CABLE FOR FEEDING LOW-TENSION MAINS AND SINGLE-CONDUCTOR PAPER-INSULATED CABLES.

lamps, and each horse-power in motors equivalent to 15 16-cp. The total installation equivalent supplied by central station service on Manhattan Island and the Bronx is 2,282,980 lamps.

The officers of the New York Edison Company are: A. N. Brady, president; N. F. Brady, vice-president and treasurer; T. E. Murray,

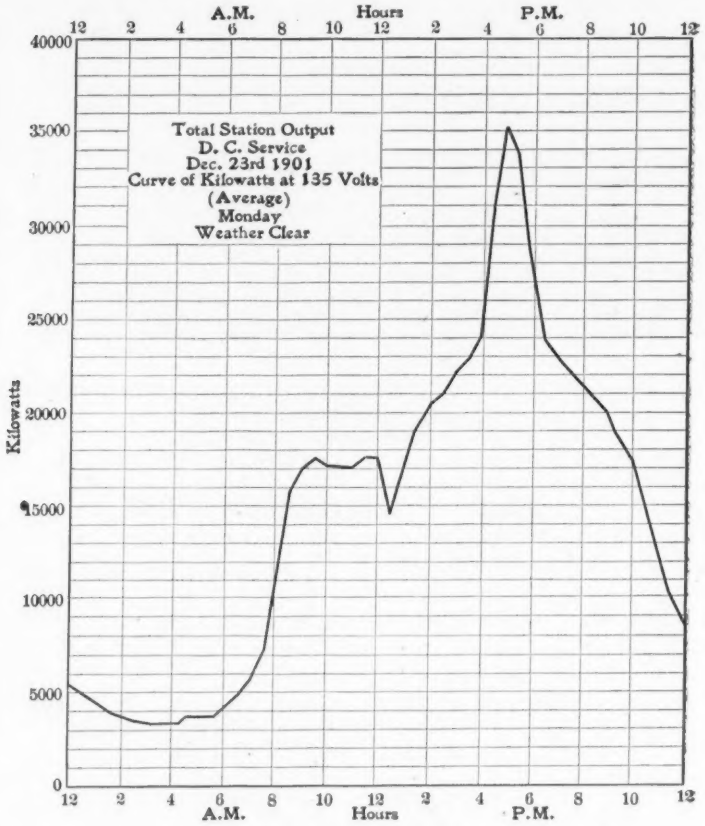


FIG. 49.—LOAD DIAGRAM.

second vice-president and general manager; J. W. Lieb, Jr., third vice-president and associate general manager; L. B. Gawtry, secretary; H. M. Edwards, auditor; Joseph Williams, assistant treasurer; and the following administrative and technical staff: C. S. Shepard, controller; Arthur Williams, general inspector; J. P. Sparrow, superintendent of construction; George Fulton, chief engineer;

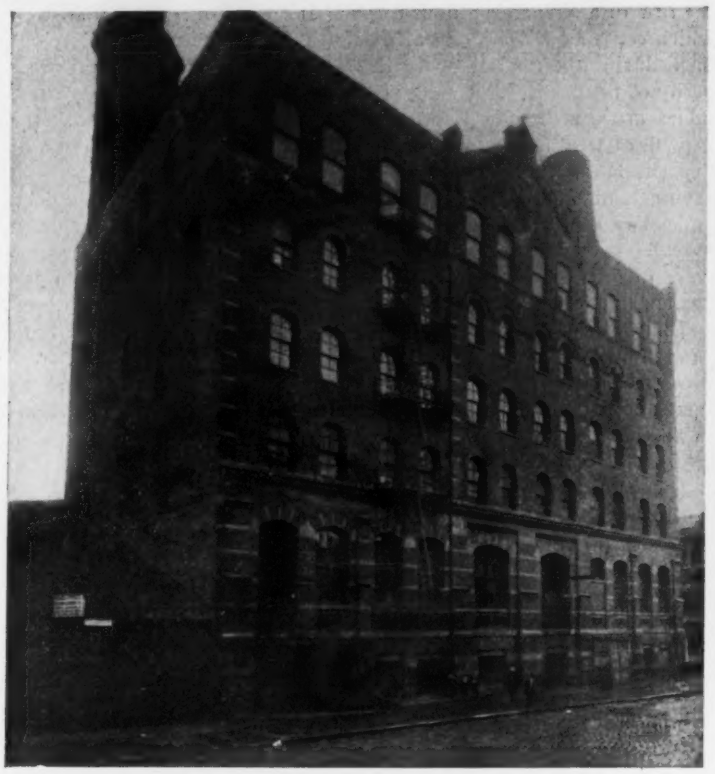


FIG. 50.—VAN DAM STREET STATION.

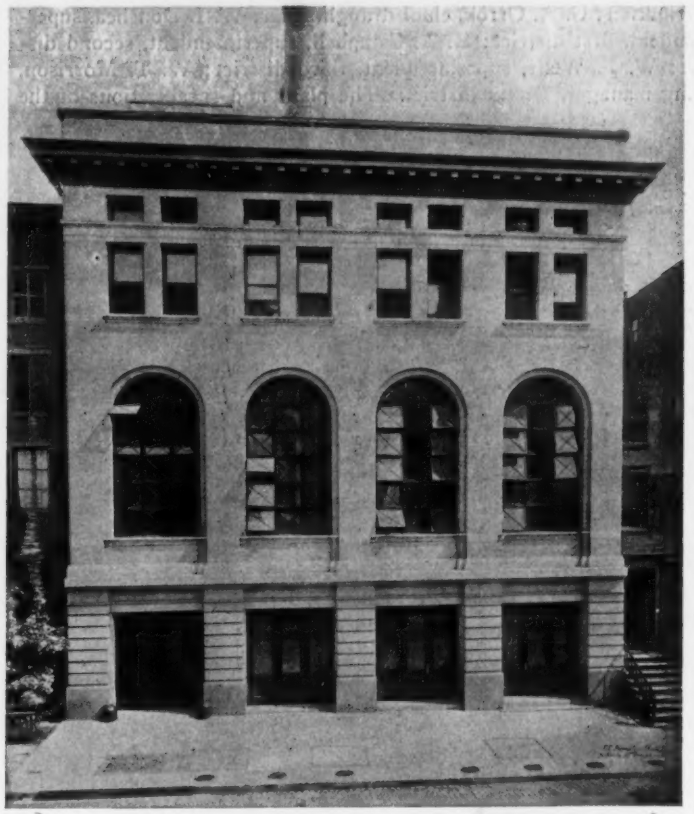


FIG. 52.—TWELFTH STREET STATION.

FIG. 51.—TWENTY-SIXTH STREET STATION.

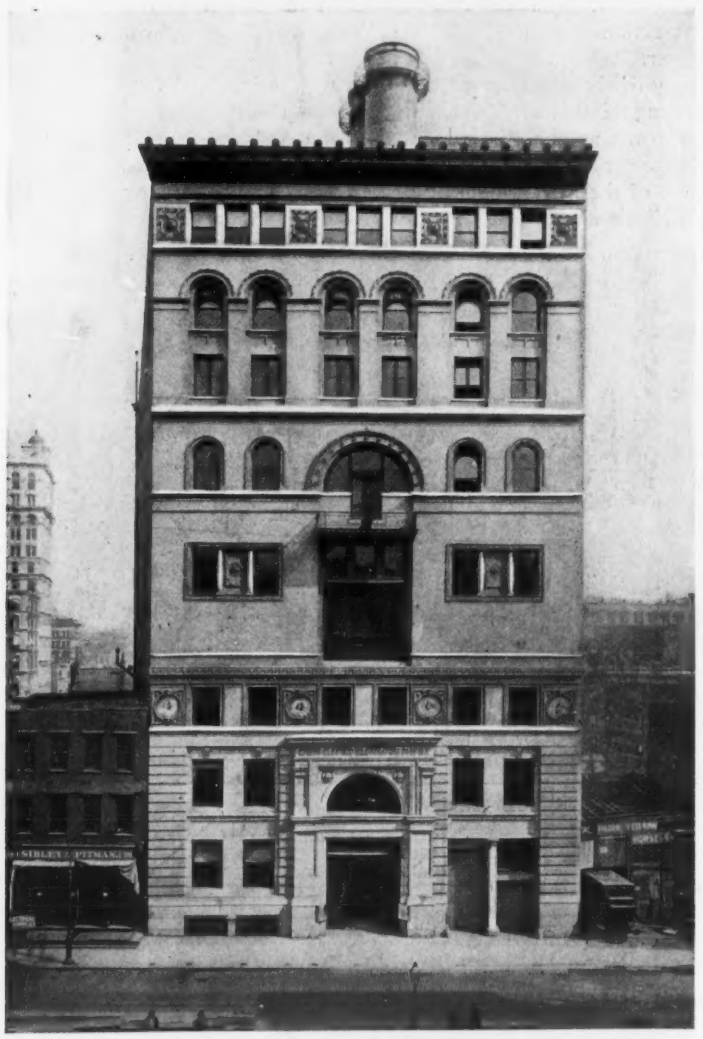


FIG. 53.—DUANE STREET STATION.

STATIONS OF THE NEW YORK EDISON COMPANY.

Henry Stephenson, superintendent of distribution; C. W. Rice, engineer of meter and testing departments; Philip Torchio, engineer of distribution; G. A. Orrok, chief draughtsman; W. I. Donshea, superintendent, first district; H. A. Campbell, superintendent, second district; W. F. Wells, superintendent, third district; W. T. Morrison, acting manager, Bronx district. The plans and specifications of the

FIG. 54.—GOLD STREET STATION.

Waterside station were prepared by the company's engineering staff, of which Mr. John Van Vleck, now of the Rapid Transit Subway Construction Company, of New York, was formerly constructing engineer.

Many of these gentlemen, to whom we are indebted for data, etc., appearing in this article, have been with the company for a great many years, as our readers are well aware. Mr. John W. Lieb, the associate general manager, has in particular been connected with the growth of the Edison lighting system from its pioneer inception, and for well-nigh a decade has contributed by admirable technical and

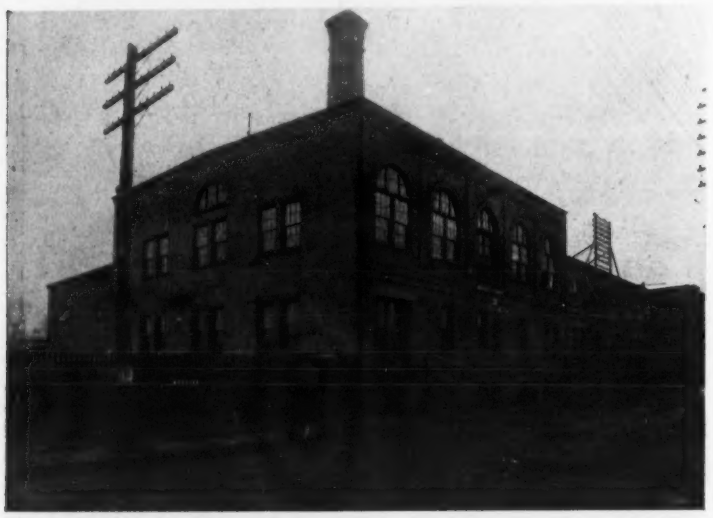


FIG. 55.—NORTH NEW YORK STATION.

administrative work to the engineering excellence of the plans and performance of the New York Edison Company. It is only necessary to have read this series of articles, to look at the map herewith, and to glance at the stations, great and small, to realize upon such a staff as that given above falls at all times a great burden of responsibility. The manner in which the task is discharged must be judged by the remarkable record, from the economical, engineering and commercial standpoint, which has been made by this, the greatest electric lighting system in the world.

The Growth and Wealth of the United States.

"The Progress of the United States in Its Material Industries," is the title of a monograph issued by the Treasury Bureau of Statistics, which contains a series of statements which show the rapid development during the century of the important factors in the present prosperity of the country. Among the interesting facts presented by these tables are the growth of production, the growth of commerce, the growth of wealth, the growth of money in circulation, the growth of deposits in savings banks and the increased number of depositors in savings and other banks, the decrease in interest on the public debt, and many other facts of this character. On the production side, it may be said that the cotton produced has increased from 155,556 bales in 1800 to 9,436,416 bales in 1900; the wool produce, from 35,802,114 lbs. in 1840 to 302,504,328 lbs. in 1901; wheat, from 151,999,906 bushels in 1866 to 522,229,505 bushels in 1900; corn, from 867,946,296 bushels in 1866 to 2,105,102,516 bushels in 1900; copper, from 650 tons in 1850 to 270,588 tons in 1900; pig iron, from 165,000 tons in 1830 to 15,800,000 tons in 1901; petroleum, from 21,000,000 gallons in 1860 to 2,661,233,568 gallons in 1900; coal, from 3,358,899 tons in 1850 to 267,850,000 tons in 1901; and gold, from $50,000,000 in 1850 to $79,171,000 in 1900.

During the period under consideration exports of merchandise have grown from $70,971,780 in 1800 to $1,487,764,991 in 1901; the per capita in 1800 being $13.37 and in 1901, $18.81. The imports of merchandise have grown from $91,252,768 in 1800 to $823,172,165 in 1901, while the per capita imports have fallen from $17.19 in 1800 to $10.58 in 1901.

Turning to the figures which show the net results of these developments, those relating to wealth, circulation, deposits, etc., the tables show that the wealth has increased from $7,135,780,000 in 1850 to an estimated $94,300,000,000 in 1900; the per capita wealth, from $307.69 in 1850 to $1,235.86 in 1900. The public debt, less cash in the Treasury, was in 1865 $76.98 per capita, and in 1901 was $13.44 per capita; while the interest on the public debt, which in 1867 was $143,781,592, had fallen to $32,342,797 in 1901. The figures of money in circulation show in 1860 a total of $435,407,252, and in 1901, $2,175,387,277. The circulation per capita in 1860 was $13.85; in 1901, $28.02. The deposits in savings banks in 1830 were $6,973,304; in 1883, 53 years later, they were $1,024,856,787, and by 1901, a further period of only 18 years, had reached $2,597,094,580. Meantime, the national banking system had come into operation, and in 1865 the deposits in national banks were $500,910,873; in 1880, $1,006,452,853, and in 1901, $3,044,600,000. The number of depositors in savings banks grew from 38,085 in 1880 to 1,067,061 in 1866, and 6,358,723 in 1901. Railways grew from 9021 miles in 1850 to 199,378 in 1901; and freight carried one mile increased from 39,302,209,249 tons in 1882 to 141,162,109,413 tons in 1900, freight rates falling meantime from 1.24 cents per ton per mile to 75-100th of 1 cent per ton per mile.

Lighting in Rio de Janeiro.

Mr. Eugene Seeger, United States Consul-General, writing from Rio de Janeiro, says: From a prominent representative of Belgian capitalists I have received the following information, which may be of interest to American investors, especially in the gas and electrical industries. The gas company at Rio, which consists exclusively of Belgian capitalists and their representatives and enjoys valuable rights and privileges, is very much in need of funds to make improvements and extensions necessary on account of the largely increased demand and the more modern requirements. In order to develop the earning power the capacity of the plant ought to be greatly enlarged and an electric plant ought to be added. The estimate of expenses for the necessary improvements amounts to about $3,000,000, which sum the company seems to be unable to raise here or in Belgium.

The capital invested in the plant up to date is about $10,000,000, and the company's contract with the city expires in 45 years. The managers would be willing to transfer all their rights and privileges and the controlling interest of the property to an American syndicate which would undertake the necessary improvements, provided they could be accorded a fair share in the net earnings of a new company to be organized on that basis.

Capitalists interested in this enterprise can have the inclosure translated for their benefit. I will, of course, be glad to procure any additional information desired.

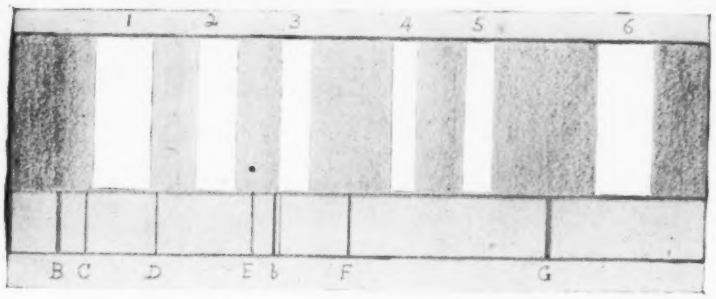
The Spectrum of the Enclosed Arc.

BY DR. LOUIS BELL.

WHILE cleaning a pocket spectroscope the other evening I chanced to turn it, to observe the working of the slit, upon an enclosed alternating series arc easily visible from my study window. The spectrum obtained was so striking and in some respects so instructive that it seemed worth while to put it on record. I doubt not that it has been many times observed, but do not recollect seeing in the technical papers any suitable account of it.

It is well known that the ordinary open arc gives a very brilliant continuous spectrum with light well distributed and possessing no considerable peculiarities of any kind. On separating the poles a bit so that the slit of the spectroscope may receive light from the arc itself instead of from the white-hot carbons one gets a combination of air spectrum and carbon spectrum, the beautiful fluted bands due to the latter showing with exquisite sharpness under high dispersion. But generally speaking the arc as a whole gives merely a strong continuous spectrum closely akin to that of sunlight.

But in enclosed arcs the conditions are very greatly changed, particularly in alternating arcs, which show no crater. The arc is long and formed in a chamber full of heated gases, mainly nitrogen and carbon monoxide. The light comes in part from the hot carbon tips and partly from the arc itself, which is of greatly enhanced brilliancy as compared with an arc in the open air. The striking thing about the spectrum derived from this source is the very great relative brilliancy of the discontinuous arc spectrum. Fig. 1 shows a drawing of the



SPECTRUM OF THE ENCLOSED ARC.

ordinary spectrum of the enclosed arc, made to scale with a direct-vision spectroscope of moderate dispersion. In the lower part of the figure are plotted the Fraunhofer lines of the sun spectrum for reference.

The spectrum of the arc light begins in the crimson near the solar line *C*, everything toward the darker red fading very quickly away. Then comes a fairly bright continuous spectrum through the orange and yellow into the clear green, and then the light fades rapidly up to the bright green of the magnesium group reversed in the sun as *b*. On this continuous spectrum are superposed two brilliant bands of the carbon spectrum, 1 and 2 of the cut. Their edges are indeterminate against the bright background, but they enhance the general light enough to give the appearance of a faint shadow between them, in the yellow of the spectrum.

Then near the solar line *b* begins the carbon band 3 of most vivid and beautiful green, intensely bright and shading off in a way no drawing can well show, into a very faint continuous spectrum reaching through the blue-green and fading into the carbon band 4, a strong, bright, full blue. This band is quite intense and fades away at the edge toward the violet into a narrow region of very dim light, the continuous spectrum here being practically invisible. A little further up the spectrum this is relieved by a moderately bright; deep blue band marked 5 in the drawing. This band falls in the place usually ascribed to a strong band in the cynanogen spectrum, but the dispersion I used was not sufficient to make its identity certain. In fact, the whole matter of the spectra of carbon and its compounds is at present in a rather uncertain state.

At all events beyond this band 5 there is a wide region of darkness, broken finally by the broad and splendid violet band 6. This like the others is due to carbon, and is conspicuously brilliant, shining at times with an intensity that makes it the most striking thing in the spectrum. Compared with the violet in any ordinary continuous spectrum it is enormously bright. Beyond it is complete darkness so far as the eye can see. The spectrum as drawn was from a 7.5 ampere, 60-cycle enclosed alternating series arc on the street. It had a clear outer and light opalescent inner globe. An examination of many similar arcs showed substantially the same results, and rather to my surprise the spectrum of the ordinary 6.8 ampere enclosed series continuous current arc proved to be substantially identical. There was perhaps a trace more of continuous spectrum, but the lower current density seems to have robbed the crater of its efficacy.

With small and larger dispersions, with wide and narrow slits of the spectroscope, the spectra of these arcs preserve the same characteristics. They are notably discontinuous, deriving most of their light from the bands of the carbon spectrum, and are marked especially by the very intense band in the violet. Some of the constant potential enclosed continuous current arcs which I examined showed considerably more continuous spectrum than the series arcs, but the carbon bands were still very noticeable.

All the spectra vary more or less from time to time in the apparent relative brightness of the various regions, as more or less continuous spectrum comes into the background, as the arcs vary slightly in length, or the inner globes in opacity, but the cut is thoroughly typical of average appearances.

The striking violet tinge of many enclosed arcs needs no explanation after a glance at the spectrum. It arises not from any unusual extension of the general spectrum toward the violet end, but from the isolated and extraordinarily brilliant violet carbon band numbered 6 in the cut. The general coloration produced is strong in inverse ratio to the brightness of the continuous spectrum of the carbon tips. With as large a current as 7.5 amperes the general color of the arc is bluish white, while with lower values of the current the hot carbons give comparatively little light, and the violet is more in evidence.

This same violet band accounts for the very remarkable photographic activity of the enclosed arc. It is well known that one can print by such arcs with the greatest facility, and small wonder, for the strong violet band lies squarely in the region of maximum actinic power for ordinary plates, a point where the ordinary continuous arc spectrum is comparatively weak.

If one objects to the violet tinge a shade or outer globe very faintly stained with aurine will bring the light to a quite normal color value or diffusion from a slightly tinted surface will answer the same purpose. But, really, with a proper current density there is no need of this even within doors, although lamps for small currents are in a less desirable case.

One of the most striking things about the matter is that an effect so generally good even in cases of color judging can be produced by a light giving a spectrum so essentially discontinuous. It gives some inkling of what could be done practically by lights like vacuum tubes making no attempt to produce a continuous spectrum, but merely giving lines and bands well distributed in color. In the enclosed arc, as appears from the cut, there is marked general deficiency in the blue, which is compensated by the relatively great intensity of the bands 4, 5 and 6. The net result is a light in which colors appear at very nearly their true values in spite of the discontinuities, provided the current density is reasonably high.

The visible color of a source of light is little index of its composition, as every spectroscopist knows, and in this instance the distribution of the colors through the visible spectrum is rather good. The absence or weakness of a primary color is the thing which makes mischief, and the strength of the red, green and violet carbon bands in the enclosed arc spectrum atones for the gaps in the transition colors to a very considerable extent.

The Canadian Niagara Power Company.

The time for the completion of the Canadian Niagara Power Co.'s work at Niagara Falls has been extended, and the agreement for this extension has been confirmed by the Ontario Legislature. It provides that the period for the completion of the works specified in the agreement of April 7, 1892, be extended to July 1, 1904, under certain conditions. The company must expend, within the Province of Ontario the sum of $500,000 in work, materials, excavations, foundations and erection of buildings, etc., by July 1, 1902, and a further sum of $1,000,000, making $1,500,000 by July 1, 1903. The company will also make default of agreement unless it shall develop at least 50,000 hp by July 1, 1904; and the company must have on that date an outflow tunnel sufficient for not less than 100,000 hp, and have actually ready for use fully 20,000 ehp.

The New Power Plant of the Citizens' Company of Rochester, N. Y.

THE new plant being erected by the Citizens' Light & Power Company, in Rochester, N. Y., will be in every respect a first-class modern electrical station, and possesses many features of great interest. The plant is situated in almost the exact geographical center of Rochester, and within less than a half mile of the center of population of the town. It is located on Brown's Race, which takes water from the Genesee River and conveys it to several manufacturing plants for power purposes. The Genesee River divides the city into two portions, from south to north. The new plant will, however, rely entirely upon steam for motive power. The reasons for this decision are, that coal is cheap in Rochester, and the water power furnished by the Genesee River, while practically unlimited during a short season of the year, falls to so low a point during the dry weather, that it is only possible at times, to get enough water from Brown's Race to run the condensers for the engines.

Water storage has been discussed in Rochester for years, but no advance has been made in this direction for so long that people have begun to regard it as something never to be realized. It is, too, probable that the expense of storing sufficient water to maintain a steady volume of water in the Genesee River during the dry months would be so great as to be absolutely prohibitive to private capital, and would be an enterprise of such magnitude as could only safely be taken up by the State. Without water storage it is necessary for all users of water to maintain duplicate steam plants of equal capacity to their water plant, and the expense of combined steam and water plants under such conditions, is conceded by all experts to be greater than that of a thoroughly up-to-date steam plant with coal at any reasonable figure.

The plant is built on the side of a cliff, which is excavated to two grades, the upper one being used for the boilers, and the lower one for the engines and dynamos. With this arrangement coal can be carted directly over Brown's Race, dumped into the storing bin and fed thence by gravity through automatic weighing apparatus into automatic stokers, and thence into an ashpit, from which the ashes are removed by a mechanical device. Rochester has become well known as the best lighted city in this country, with about 2800 arcs out of a total of 2930 street lights, and there is practically an unlimited demand for lighting and power from all parts of the territory. We will now proceed to details of the new work.

The Citizens' Light & Power Company, which commenced operation in the fall of 1892, had their plant ready for business Nov. 17, 1893, on Brown's Race, an artificial waterway 36 ft. wide by 7 ft. deep, running from the river at Central Avenue to Brown Street, where the overflow returns to the river. The Citizens' Company built its plant on the river bank below this race, which gave them a head of 93 ft. The original plans were for a building eight stories high, but were finally cut down to three stories and a wheel pit. The company started in with one or two machines, but at the time of the destruction of the plant by fire on Nov. 25, 1900, they had installed and were operating three 500-hp waterwheels, two 600-hp Corliss engines, and one Woodbury tandem compound 600-hp engine, all of which were connected with four jack-shafts on the floor above by rope drives running 7000 per minute. In the boiler room there were eight horizontal tubular boilers of 125 hp each. This steam plant was a very necessary adjunct, as the Genesee water supply is a very precarious and uncertain quantity, the company being obliged to carry a full head of steam always, as they could take no chances of having their business interrupted.

On the floor above the shaft room was the dynamo room. In it there were installed six 150-kw, double-current Westinghouse dynamos, belt-driven from clutch pulleys on the jack-shaft below. They gave 380-volt, two-phase, 50-cycle alternating-current from one end and 500-volt, direct-current from the other end, the idea being to operate all the alternating-current ends in multiple on the alternating-current switchboard and all the direct-current ends on the direct-current switchboard, but were finally operated by running the alternating-current ends together and putting in two Westinghouse 150-kw multipolar machines for the 500-volt work, as there was usually a pyrotechnic wind-up when they attempted to operate both ends at once. They also had two Western Electric 60-light series arc machines.

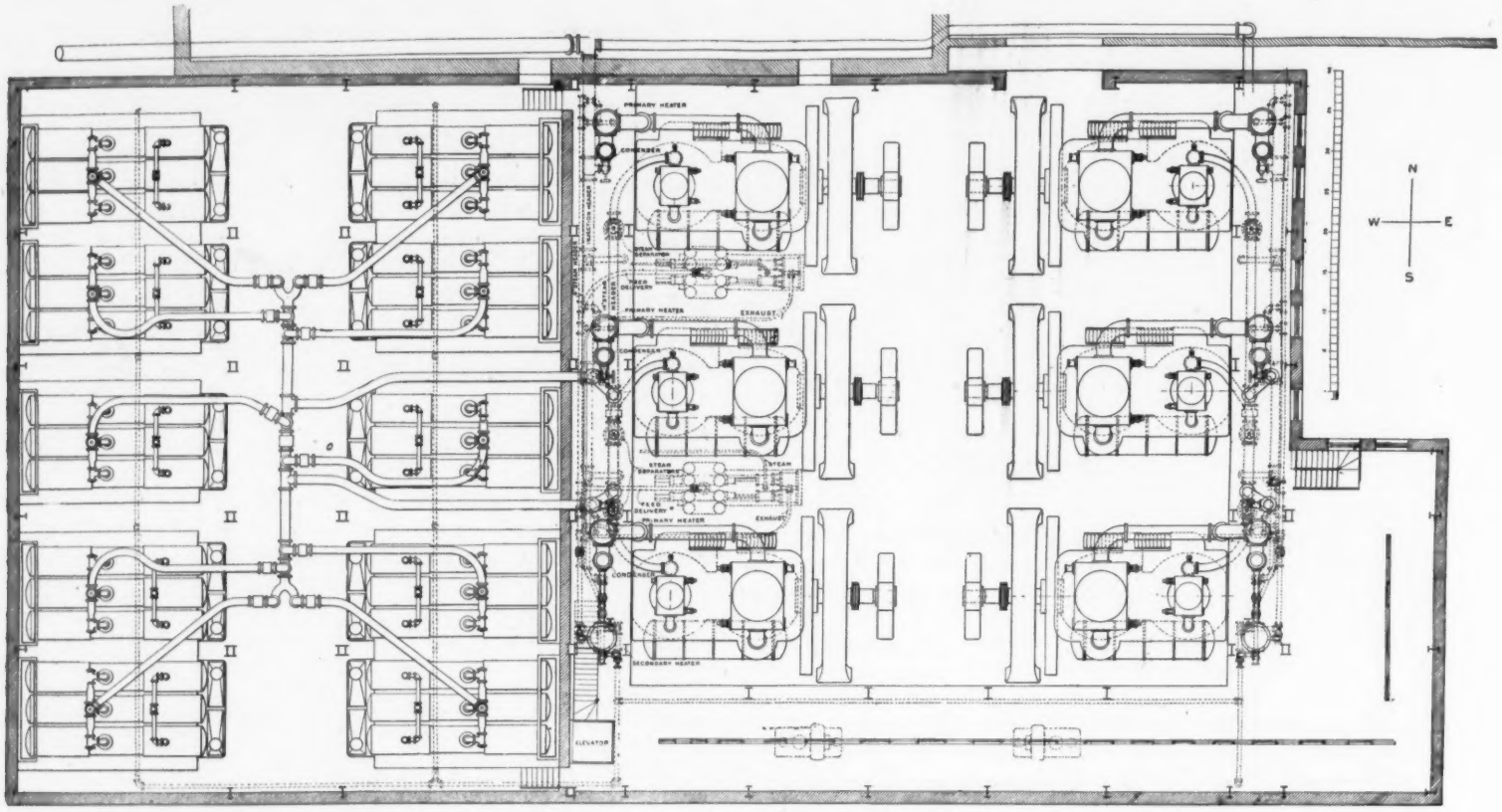


Fig. 1.—Plan of Citizens' Company's Station, Rochester, N. Y.

After this plant burned down it was bought by the present company, and the old station was reconstructed, to be operated until a modern direct connected plant could be built. The reconstructed station consists of the same engines and waterwheels; one jack-shaft was cut out, and two 180-kw Westinghouse two-phase, 2200-volt composite alternators were installed to replace three of the old double-current machines, three of which were installed again, two being used for power along with the two 150-kw multipolar Westinghouse 500-volt machines, and one on lighting circuits separately. The 180-kw machines were run in multiple on the balance of the load.

Business came in so fast that the company decided to erect a tem-

porary engine at once on the site of the new plant; consequently, a direct-connected 500-kw Stanley unit was installed, driven by a horizontal cross-compound Dickson engine and a 650-hp water tube boiler. This machine is also run in multiple with the 180-kw machines, the composite commutators being disconnected and the series and separate winding being connected in series on each machine.

On Christmas Eve all these machines were overloaded, and had an exact balance on every phase, and their proper share of load in proportion to their size, the total being 900 kw. These dynamos were being driven by hand-regulated waterwheels and Corliss engines on the same shafts, and the 500-kw unit by a cross-compound condensing engine, and they worked to perfection. The company also replaced the Western Electric arc machines with three Thomson-Houston light arc machines. The 530-volt direct-current power load goes as high as 800 amperes, and the alternating-current lighting load to 400 amperes at 2260 volts, and two arc machines fully loaded. A load diagram of that date is shown in Fig. 5.

Just south of the old station is a piece of property about 200 ft. long by 96 ft. wide, which was occupied in part by an old factory. This property was acquired, and the old buildings were torn down, revealing the solid rock extending from the race on the west, at an elevation of about 99 ft. above low water to a factory building on the eastern side, about 23 or 24 ft. above low water. On the south side of the new property is located a large factory building, so that in excavating for the new station it was necessary to channel the rock at a distance from the property line of about 2 ft., in order to preserve the adjoining foundations from injury. This left a width of about 93 ft. on which the new station could be built. After a number of studies, it was decided that the engine house should be erected on the end of the lot towards the river, with the boiler house on a step of such height that the coal for use in the station might be driven in the ordinary coal carts from the race street on to the roof and dumped through holes into a coal pocket, which should be situated above the boilers. The race itself runs in a general northwesterly and southwesterly direction, 43 ft. from the building, along the northern side of the lot and 10 ft. from the building at the southerly side. The rock on this line was channeled down to about a grade of 58 ft. for the main floor of the boiler house. The boiler house basement, which is only of sufficient width to take in the two ash-hoppers and the center aisle, was channeled down 10 ft. deeper, while a step of 30 ft. was made to take the west wall of the engine room. The solid rock was leveled up with concrete to about the grade of various floors, as shown on the cross-section, and preparation was made for receiving the steel work, which will shortly be erected.

The design of the building is similar to that of other large electric lighting stations which have been built in the last year, notably that of the Third Avenue station of the Brooklyn Heights Railway Company, Brooklyn, N. Y. The engine room has mezzanine floors on either side, which support steam piping, condensers and other auxiliary apparatus, leaving the engine room a clear space, devoted to engines only. The engine house proper is approximately 76 ft. square inside of the columns, and is spanned by an electric traveling crane of 35 tons capacity, made by Alfred Box & Co., of Philadelphia. The engines themselves are set in two lines, running north and south, with the shafts running east and west, 25 ft. 9 inches from center to center. The generators are outboard of the engine, occupying the center of the engine room, leaving an aisle 10 ft. wide between the two lines of generators.

On the east and west sides of the engine room the four mezzanine floors are placed, the two lowest being continuous with the engine platforms. The third mezzanine is used for the support of the condensers and heaters, and the fourth mezzanine, 46 ft. 8 inches above the engine room floor, has as its outer edge the supports for the crane runway. Eight ft. above this mezzanine floor extends the lower chord of the engine room trusses, which span the engine room from wall to wall 90 ft. in the clear. These trusses are 9 ft. deep at the ends, with the upper chord on a slope ½ inch to the foot, to provide drainage for the roof. A monitor, to give light and afford ventilation for the engine room, extends down the center of the roof, in a north and south direction, above the trusses.

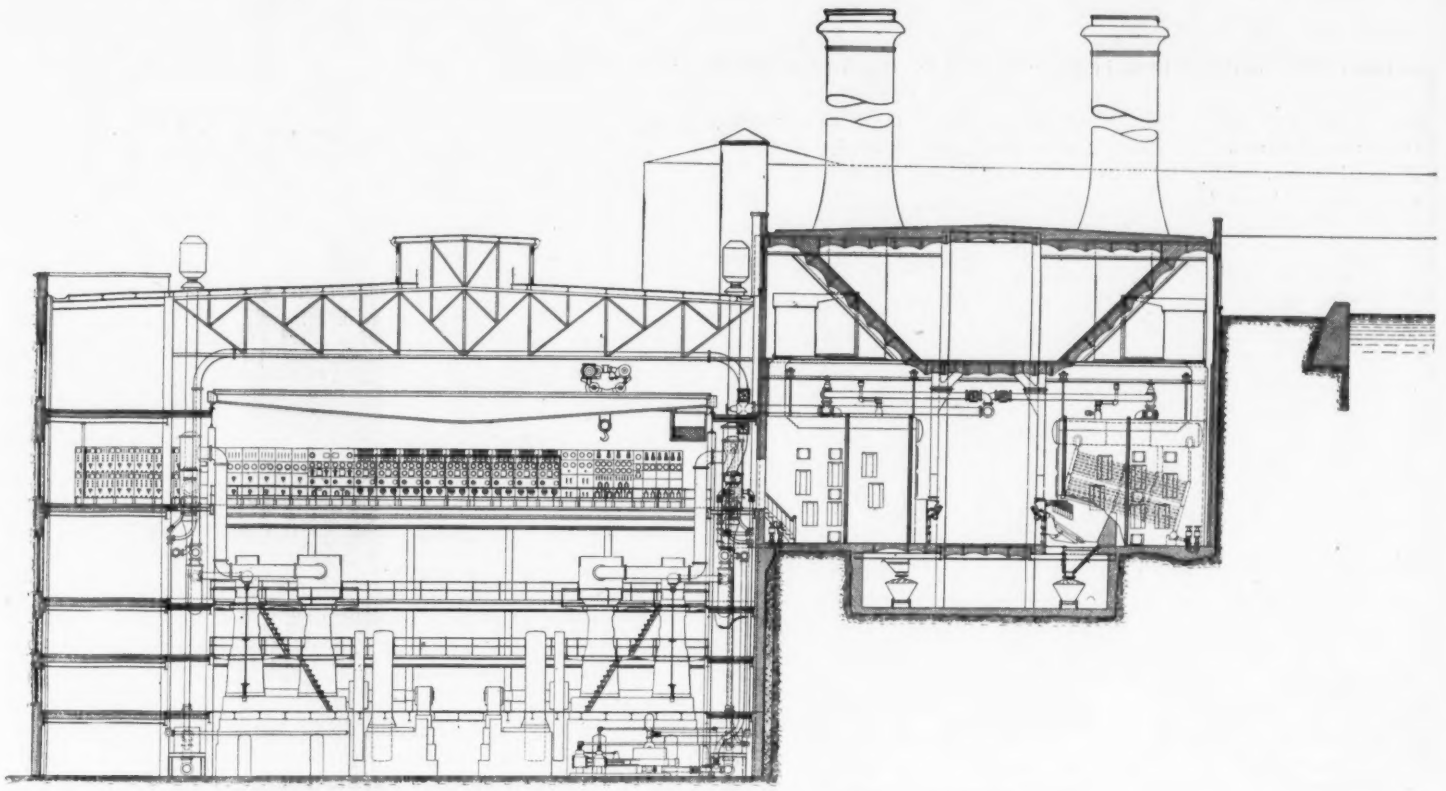


FIG. 2.—ELEVATION, CITIZENS' COMPANY'S STATION, ROCHESTER, N. Y.

At the south side of the engine room are three electrical galleries. The two lower are 12 ft. 6 inches wide, but the upper, on which the switchboard is located, is 16 1-9 inches wide. On the southeast corner of the engine room an addition extending up the full height of the building, 18 ft. 6 inches by 43 ft., serves for additional switchboard space.

The boiler house is 89 ft. 4 inches by 68 ft. 7 inches in the clear, and when complete will contain ten 650-hp B. & W. type boilers, made by the Aultman & Taylor Company, of Mansfield, Ohio, set in four batteries of two boilers each, occupying the four corners of the boiler house, with a single boiler set in the center of either side occupying the space immediately under the stacks. The boilers are set with no space behind them, cleaning doors being provided at the side instead of in the back. The boilers will be fitted with Acme stokers and smokeless furnaces of the latest type.

The up-takes from the boilers will occupy the full width of the

boiler, the back wall being protected by a cast iron plate. These up-takes go directly upwards into the bottom of a flue, which extends the full length of the boiler house on each side, discharging into the bottom of the stacks near the center of the station. The coal pocket having a capacity of 1300 tons, occupies the second story of the boiler house.

The roof over the boiler house is made sufficiently strong to support large coal wagons, which will deliver fuel for use in this station. Numerous hatches are provided, so that the coal may be dumped into the coal pocket and entirely fill it without trimming by hand. The foundations for the stacks are also in this roof, and consist of heavy beams and girders, as will be noted from the description of the structural work. The plate stacks themselves are 10 ft. 3 inches in diameter, 178 ft. above the grates, and 130 ft. above the base or foundation girders. They are lined for 20 ft. above the base with 4½-inch firebrick, and are two in number, standing on the east and west center line of the station, about 41 ft. from center to center. They are surmounted with a lotus, of neat design. A boiler house roof bridge, on a grade of 5 per cent, connects the roof with Brown's Race, forming a runway over which the coal carts can pass, to attain the roof of the station. From a point on the roof of the engine house, near the center of the south wall, a cable runway is built above the roof, following the southerly line of the building and bridging Brown's Race to a cable tower on the west side of the race. Through this cable runway all the electrical cables of the station will be taken to the underground conduits.

The outside building lines in many cases, are only 6 or 8 inches away from the rock, which often extends as much as 40 ft. above the base of the wall, and provision has been made for the water-proofing of the outside of the wall and the proper draining of the space enclosed between the rock and the water-proofing. The walls themselves are to be built of the best hard burned red brick, of selected quality and color. Up to the original rock level the walls are to be laid up in Portland cement, and above this in Rosendale cement. The interior exposed walls of the engine room are to be faced with a hard, light buff face brick, with an enameled brick wainscot running around the engine room about 5 ft. above the floor. This is to be of white enameled brick, with the three lower courses of chocolate color brick.

All floors, with the exception of the main floor of the engine-room, are of expanded metal construction, faced with a 2-inch coat of granolithic finish. The engine room floor itself is to be made of cast iron checker plates, ¾-inch thick, and properly ribbed. The roof of the engine room will consist of terra cotta roofing tile, laid between T-irons, covered with composition roofing and slag. The roof over the boiler house is to consist of expanded metal arches covered with composition roofing and vitrified paving brick, laid on edge, in roofing cement.

As the station has no frontage on the street, the main door of the station will be situated upon the roof, near the partition wall at the south side of the station, and stairs and an elevator will connect this entrance with various floors of engine and boiler rooms.

The engine and generator foundations are of monolithic concrete moulded in wooden forms. Granite capstones are omitted as the quality of the concrete will be excellent, and the heavy cast iron engine and generator bases will be leveled up and grouted with fine gravel concrete. Besides carrying the engine these foundations support the floor beams for the main floor.

Two styles of steel supporting columns are used, one made up of two 12-inch channels, with 16-inch cover plates, and the other of one 16-inch plate and four 6-inch by 4-inch angles, the latter being used in the walls and supporting the crane girders where a greater resistance is required in one direction than in another. As the entire station rests on solid rock, and it being possible to so level the rock off that the base plates on the columns come down to within about 1 to 3 inches of the top of the rock, the column bases were proportioned so as to give under full load a pressure of 36 tons per square foot. This permitted the use of steel bases riveted to the bottom of the columns.

The engine room proper is 76 ft. wide, center to center of columns, supporting the mezzanines and crane girders, and 76 ft. 6 inches long, with mezzanine floors on each side, 6 ft. 10 inches wide. The first two mezzanine floors are on the same level with the engine platforms, the third mezzanine floor is on the same level as the main electrical floor and carries the primary and secondary feed-water heaters and conductors, and the fourth mezzanine floor is 6 inches below the top of the crane girders, and is supported on one side by them as will be seen by referring to the cross section of station. The crane girders supporting the 35-ton crane are 76 ft., center to center; and as it is absolutely necessary that this span be maintained throughout the entire length, a special means of adjustment was designed by which this could be accomplished, by the use of packing plates.

The boiler house is 69 ft. 11 inches wide center to center of columns, and 89 ft. long. The boiler fronts, the automatic stoker, the concrete ash hoppers and part of the side walls of the boilers are supported by the main boiler house floor, but the boiler drums and tube sections are hung from pairs of 15-inch I-beams, which frame into the horizontal coal pocket girders. Above the boilers is the coal pocket, which is 21 ft. wide at the bottom with sides sloping at 45 degs, and 17 ft. 6 inches high to the bottom of the boiler house roof beams.

As the coal is delivered by means of large coal wagons driving over the roof and dumping directly into the coal pocket through any one of the 18 coal holes, it was necessary to make the roof of a substantial and heavy construction. The girders in the boiler house roof are made up of one web plate 36 inches wide and four angles 6 inches by 6 inches, with 14-inch cover plates, where required, and the floor beams are 15-inch by 42-lb. I's, spaced about 3 ft, 6 inches apart. In the center bay of the boiler house are located the two stacks, each stack being 20 ft. 6 inches from the center of the building. The stacks are supported from the boiler house roof by a heavy system of girders and beams. The entire structural work, including the stacks and flues, the stairways, and ornamental facial work is furnished by the American Bridge Company.

The station is designed to accommodate six vertical cross-compound engines, three of which are at present being built in the shops of the Southwark Foundry & Machine Company, Philadelphia. Each engine is arranged to drive one 1360-kw, 2400-volt, 60-cycle alternator placed between the low-pressure side of the engine and an outer pedestal. The diameters of the cylinders are 28 and 68 inches, giving a ratio of 6, and the stroke 48 inches. The engines are designed to run at a normal speed of 90 r. p. m., with an initial steam pressure of 160 lbs. and a vacuum of 26 inches. Under these conditions each engine will develop 1800 hp at 30 per cent cut-off, and a maximum of 3000 hp. They will, however, be built strong enough to work under 200 lbs. steam pressure.

When running with the most economical load they will require less than 13 lbs. of dry steam per ihp per hour, including the steam used in the reheater, while the steam variation from no load to full load will not exceed 3 per cent from the normal. Under any change of load, the internal variation of speed will not exceed ¼ of 1 geometrical degree from the position of uniform rotation. The design of the engines is a most pleasing one, and the massive construction of the parts will at once impress one upon an examination of the outline drawing.

The shaft is of open-hearth forged steel, having a single arm crank on the high-pressure end, and a double-arm crank on the low-pressure side of open-hearth cast steel ,and counterbalanced to offset the weight of the reciprocating parts. The flywheel is 20 ft. diameter, and weighs, with the armature sleeve, close to 125,000 lbs. It is made of cast-iron segments, securely held together at the rim by tee-headed shrunk links, and at the hub by means of fitted bolts through the arwhich lap the joints in the cast-iron rim, and are secured to it by through rivets. The armature sleeve is bolted directly to the spokes of the generator, thus relieving the shaft of any strain between the flywheel and generator.

These engines, as indeed all engines for 60-cycle, three-phase generators recently built by the company, use the King regulating device for readily synchronizing the machines. The operator on the switchboard sends current at will through a small motor, which acts as a governor counterweight, thus enabling him to vary to any extent, the speed of the engine. The governor is of the well-known Porter type, and controls the cut-off on both the high and low-pressure cylinders. It is driven by steel cut spur gears direct from the main shaft of the engine.

The reheating receiver has a reheating surface, which appears tremendous when compared with the short tubes in some of the reheaters recently described, but the builders claim that this is absolutely necessary if the steam economy is to vary but slightly under all conditions of load. The total weight of each engine is about 500,000 lbs., and the dimensions of the principal parts are as follows:

Main bearings—inner (2)	18 in. × 24 in.
Main bearings—outer (1)	22 in. × 40 in.
Outer bearing (1)	20 in. × 30 in.
Crank pin—high-potential	12 in. × 10 in.
Crank pin—low-potential	15 in. × 10 in.
Cross-head pins (2)	9 in. × 10 in.
Piston rods (2)	6½ in. diameter.

A Bulkley condenser is provided with each engine, capable of condensing 24,000 lbs. of steam per hour, and maintaining a vacuum of 26 inches when supplied with cooling water at 75 degs. F. The usual automatic free exhaust valve and connections are placed in the exhaust pipe of each engine, and a Wainwright feed-water heater, suitable for 1800 hp, are fitted with corrugated copper tubes, is connected to each engine exhaust pipe.

The feed water is taken from the hot well or from the city water connections, and is handled by two duplex outside packed plunger pumps, with two 12-inch diameter high-pressure cylinders, two 18-inch diameter low-pressure cylinders, four 9-inch diameter single-acting water plungers, with a common stroke of 18 inches. These pumps are to work against 250 lbs. water pressure, and either is sufficiently large to handle the entire installation. They were furnished by Thomas A. Lewis. From the pumps feed water is taken through the primary heaters, located in the exhaust pipe between the engine and condenser, then to the secondary heater, where it is heated nearly to the boiling point, and from thence into the feed mains, which run along underneath the boilers immediatley in front of the ash hoppers, where connections are made to the vertical lines at the side of the boiler, as mentioned before.

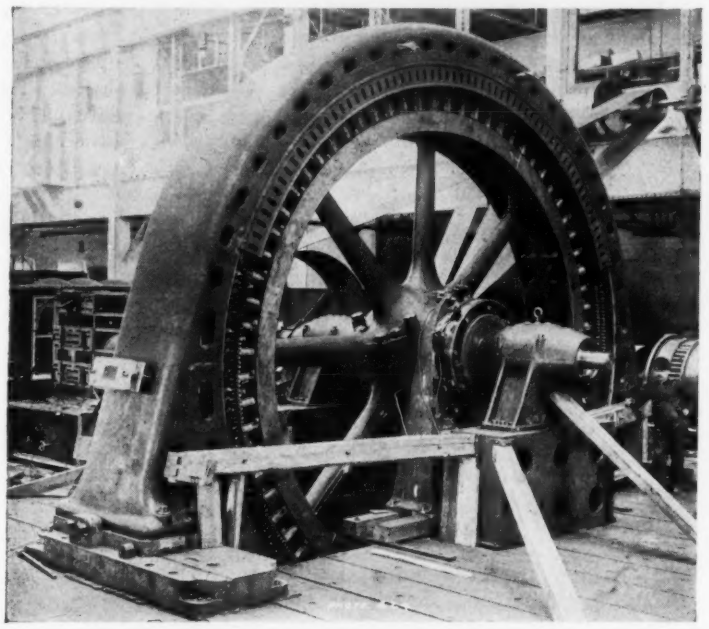


FIG. 3.—1360-KW GENERATOR ON TESTING FLOOR.

Both the primary and secondary heaters were furnished by the Taunton Locomotive Manufacturing Company, and are of the Wainwright evenflow type with corrugated copper tubes. There are six primary heaters.

GENERATING APPARATUS.

The generating apparatus consists of six 1360-kw, 2500-volt, two-phase, 60-cycle, 90 r. p. m. steam-driven generators, installed in the main station, and three 350-kw, 2500-volt, two-phase, 60-cycle water-wheel generators, direct connected to three turbines, installed in the adjoining station, transformed into an extension of the main operating room. The 1360-kw steam-driven generators, which are of the revolving field type, are designed to carry full rated ampere load and voltage, with a power factor of 80 per cent, and also to carry at rated voltage 25 per cent ampere overload at 90 per cent p. f. for three hours, or 50 per cent ampere overload at 95 per cent p. f. for one hour, after a continuous full-load run, without heating more than 60 C. (by resistance) over the surrounding air. The waterwheel Stanley generators have also a liberal overload capacity and low-heating limit. The excitation of the present generators is provided by two steam driven 75-kw, 125-volt, direct-current exciter sets; but later an induction motor exciter will be added to supplement the steam-driven exciters. These were installed first on account of the greater reliability for continuous service, the excitation of the generators being thereby made independent of any electrical disturbance, which might affect the regular operation of the system, and also on account of the relatively high economy realized by utilizing the exhaust steam to heat the boiler feed water, as this station has no other steam auxiliaries except the boiler feed pumps and stoker engines.

In this station will also be installed three 500-volt motor-generator sets, to replace the old equipment in the old station, and to provide new capacity for this service. These motor-generator sets consist of two sets of 250-kw and one set of 500-kw, 500-volt compound-wound generators, direct driven by 2200-volt synchronous motors. The motor-generators will be started from the direct-current side, and to provide direct current in case of shut-down of the 500-volt direct-current supply a 50-kw, 500-volt direct-current generator has been installed at one end of one of the exciter engine shafts furnished with a coupling. This small generator will also be used to carry light loads as well as for occasionally starting the motor-generator sets.

All electrical connections of generators and exciters, etc., are brought to the operating switchboard in the gallery, running east and west on the south side of the station, and having a lateral extension on the east wing of the station. On this gallery and at the center

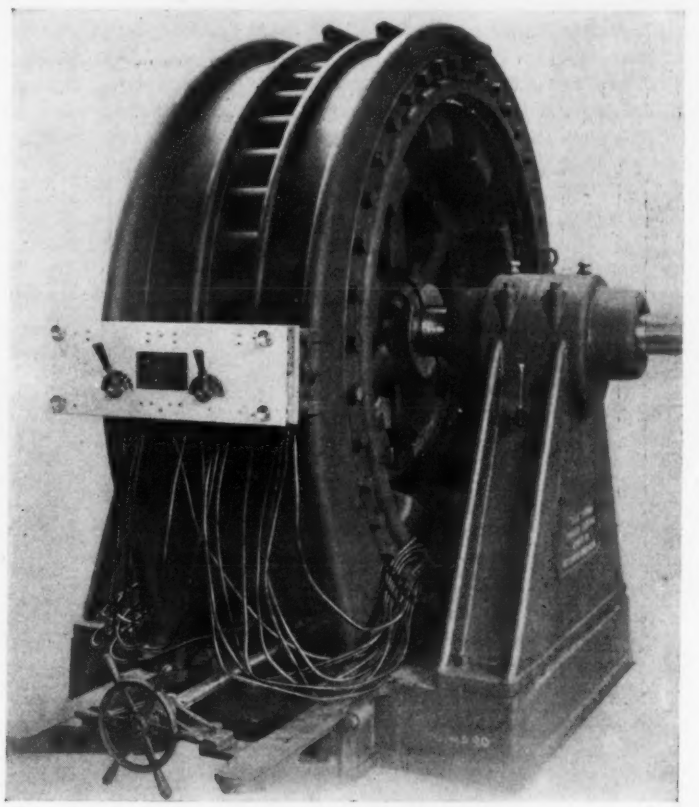


FIG. 4.—350-KW INDUCTION GENERATOR.

facing the center aisle of the operating room are placed the nine generator panels, with instruments and switching gears on the front of the panel and two sets of busses with transformers, etc., on the back. The main switches are single-throw oil switches, with an independent oil tank for each of the four legs of the two-phase circuit. From the oil switch the circuit is brought to a specially designed two-bus knife blade selector switch mounted on top of the panel and operated by a system of gears and levers controlled from the front of the panel. These switches make connections to the two independent sets of bus-bars and enable one to operate different generators on different bus-bars whenever it may be desirable to do so to ensure the continuity of service of the whole system. Each generator panel is equipped with two alternating-current ammeters, one alternating-current voltmeter, one field ammeter, an indicating wattmeter, a ground detector and a synchronizer consisting of two transformers, one on the machine side and one on the bus side of the oil switch, with two synchronizing lamps and a switch in series as well as generator and field switches and an overload relay. The field rheostats are located on the mezzanine floor below the operating switchboard with rheostat dials clamped to iron beams below with pedestal and controlling wheel mounted above in front of each machine panel, and within easy reach of the operator.

On the east side of the machine panels are mounted the exciter panels equipped with ammeters, voltmeters, ground detectors, field rheostat dials, etc., and necessary switches. After the exciter panels come the alternating-current lighting single-phase panels, with two circuits to each panel. Each circuit has a double-throw oil switch, one ammeter and two expulsion fuse blocks. At the extreme end, and on the bend along the eastern ring of the gallery is provided ample space for alternating-current series arc lamp panels.

At the west side of the generator panels are mounted four power panels controlling four two-phase high-tension cable feeders transmitting 2500 volts two-phase current to the direct-current motor generator sub-stations. For safety as well as for economizing space and bring all apparatus within easy supervision of the switchboard attendant, two electrically-operated oil switches, one for each set of busses, have been adopted for these power panels, on which are only mounted two ammeters, one power factor indicator, one polyphase wattmeter, one overload time limit relay and a set of small switches controlling the two electrically-operated oil switches erected on the mezzanine floor below. On the same panels are also mounted synchronizers, which allow to synchronize and close both switches at the same time, thereby tying together the two busses. The load can then be shifted from one bus to the other bus, and the first set of switches opened, thereby disconnecting the sub-stations from the bus without disturbing their operation. Under normal operation, however, the two oil switches on the power panels will be interlocked so as to prevent unintentional closing of both switches at the same time. Following the sub-station power panels there are two power panels

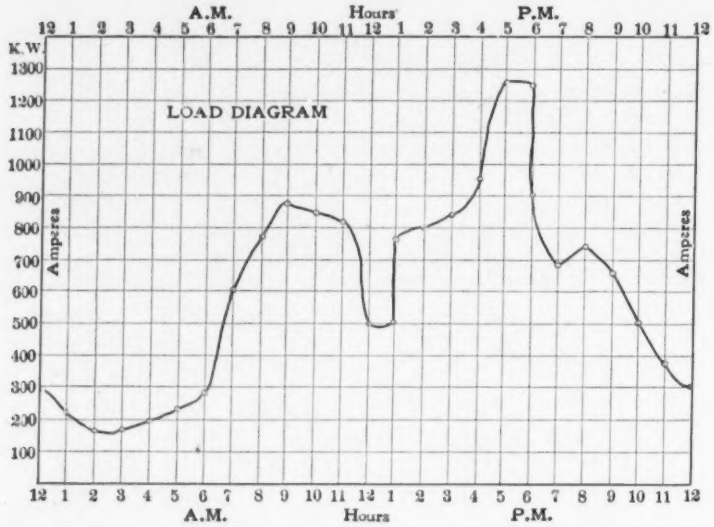


FIG. 5.—LOAD DIAGRAM.

for the 500-volt motor-generator sets installed at the station. Also, for these panels electrically operated oil switches, mounted on the mezzanine floor below, have been adopted, and on the panels are mounted the main 500-volt direct-current switches and field switches, the small starting switch, the switches controlling the E. O. oil switches, the synchronizing lamps and also alternating-current ammeter, p. f. indicator, direct-current ammeter, time limit relay, direct-current circuit breaker. The instruments and switching gears of the two 250-kw units are mounted on one panel and the 500-kw unit, with the 50-kw starter and motor-generator starting switch are controlled from the second panel. Field rheostats and dials are on the floor below, and are operated from stands in front of the panels.

The 500-volt direct-current passes then through a totalizing panel, with ammeter, wattmeter and ground detector, and feeds three direct-current feeder panels, two circuits on each panel, each circuit being equipped with knife switch-current breaker and ammeter.

From the switchboard gallery all wiring is carried in suitable ducts and cable racks to the large manhole in the street outside the station, and from this point the cable circuits are carried underground to the center section of the city, or to the other sections of the city where overhead distribution is used.

The sub-station power feeders are made up of paper-insulated, lead-covered duplex cables, drawn into tile ducts, with manholes at every street intersection. There is now only one sub-station located at Minerva Place, near main Street, and at the center of distribution of the business section. The sub-station was a manufacturing building, of which only the basement and first floor have been used for the sub-station, leaving the tenants above undisturbed. In this sub-station are now being installed two motor-generator sets, consisting of one 500-kw synchronizing motor, operated from the 2200-volt, two-phase supply, and driving two direct-connected 250-kw, 135-volt, 360 r. p. m. direct-current generators. In addition a small 75-kw motor-generator set is installed, to be used as a starter as well as to operate at light loads.

All switchboard apparatus is mounted on the same gallery, running lengthwise one side of the building. At one end are the machine panels, with oil switches, bus-selector switches, instruments and synchronizers and overload time limit relays. At present there are no feeder panels, the machine panels being now used also as feeder panels, the feeders being connected to two sets of bus-bars, from either of which any machine can be operated by means of the bus selector switches. Field rheostats of motors are installed underneath the gallery and rheostat dials are controlled from the front of the switchboard.

The low-tension, direct-current switchboard, separated from the high-tension switchboard by heavy soapstone barriers, is divided into three sections, in this order: First, the neutral bus, from which the operation and regulation is accomplished; second, the positive outside pole switchboard for generators and low-tension feeders; third, the negative outside pole switchboard for generators and low-tension feeders. On the neutral switchboard are mounted the main neutral switches, field switches and starting switches, with field rheostat dials, ammeters, station voltmeter and standard feeder voltmeters. The outside pole switchboards have two sets of bus-bars, which can be tied together, and each feeder is equipped with an ammeter. The low-tension feeder cables drop from the feeder switchboards, and, properly racked, are brought to the cable vault, where connections are made to the underground cable feeders. These are drawn into subway ducts and brought to the intersection of Minerva Place and Main Street, where they branch out in different directions, in the existing subways, reaching out into the heavily loaded districts in this section of the city.

The company is now using concentric cables of 1,000,000 cm. sectional area for each conductor, with six pressure wires for feeders and 350,000 cm. and 200,000 cm. single-conductor cables for mains. The neutrals are now of 350,000 cm. section, but 1,000,000 cm. cable will also be used. All low-tension cables are paper-insulated, and are designed for a working pressure of 750 volts direct-current.

It may be wondered at first that a steam-generating plant of this size and importance should have developed in this section where water power is at times so plentiful, but the parties responsible are very confident of the advantages of steam generation over water power, basing their claims first on the fact that water power is uncertain and inadequate at certain periods, which makes it necessary to install an auxiliary steam plant of equal capacity to the water plant, thereby adding expense to the investment account, as well as to the production cost; second, that the water power has to be utilized at several stations, which is detrimental to the economy of operation; third, that the steam plant and the water plants require duplication of station apparatus and transmission lines, and, fourth, that in a highly efficient steam plant, with the price of coal as low as it is in Rochester, the cost of coal is a small factor of the total cost of production and distribution.

The entire plant has been designed under the supervision of Mr. Thomas E. Murray, of New York City, who has conferred as to local exigencies with Mr. M. J. Warner, the general manager of the Citizens' Light & Power Company, and Mr. A. Anderson, the operating superintendent of the Citizens' Light & Power Company. A sufficient guarantee of the efficiency and excellence of the plant is furnished by the fact that Mr. Thomas E. Murray has designed in the past such stations as the Kings County Electric Light & Power Company, of Brooklyn, N. Y., of 10,000 hp capacity; the Waterside station of the New York Edison Company, with a capacity of 150,000 hp; the station of the Equitable Gas & Electric Company, of Utica, N. Y., of 3000 hp capacity, and the Third Avenue station of the Brooklyn Rapid Transit Company, of Brooklyn, N. Y., with a capacity of 50,000 hp.

The fact that the Citizens' Light & Power Company will generate alternating current at 2200 volts will result in giving the citizens of Rochester as satisfactory electric service in the outskirts of the town as in the center, a great desideratum not enjoyed before.

FIG. 1.—PERSPECTIVE VIEW OF THE PHILADELPHIA MINT.

The Electric Light and Power Plant of the New United States Mint, Philadelphia.

BY CLAYTON W. PIKE.

THE new United States Mint, of Philadelphia, is one of which every American may justly be proud. In architectural beauty few of our public buildings are its equals. In size and arrangement no other mint, either in this country or abroad, rivals it, while in completeness of mechanical equipment and in the modernness and novelty of apparatus, and particularly in the extensive use of electric power transmission it far surpasses all others.

The foundations and vaults of the building were started in the spring of 1897, while the superstructure was not commenced until 1899. The contract for this work was awarded to the late Mr. Charles McCaul. Owing to the very great care which had been used in the preparation of the plans for this work, it was possible to complete the building in a period of time which, considering the nature of and materials employed in its construction, was extremely short. So that the completed building was turned over to the local Mint authorities by June 13, of this year, while parts of the building had been in use for several months before that date.

The coining machinery, the power plant, the electric transmission, together with the extensive subsidiary electric apparatus, was installed under the plans of Mr. Edwin S. Church, the superintendent of machinery of the Philadelphia Mint. The electric generators which furnish the current for both power and light were furnished by the Crocker-Wheeler Company, of Ampere, N. J. Almost all of the motors used throughout the entire building in the various processes and on the punches, rolls and other machines are of the same make as the generator.

This building having been started before the Tarnsey law went into effect, the design was made in the office of the supervising architect. To those who are familiar with the government architecture during the past few decades, the result is no less of a surprise than a gratification. The supervising architect has been represented continuously at the building by the resident superintending architect, Mr. Amos J. Boyden, assisted by Mr. R. H. Chappelle, the inspector of mechanical and electrical work, and to the continuous presence of these gentlemen is due a great deal of the rapidity with which the building has been completed.

It is not uncommon at the present time to hear jibes, sometimes good-natured, at the slowness and perhaps inefficiency of governmental departments. The writer, in contrasting his experience in this building with that in others, is led to wish that forethought and judgment in design, and knowledge and care in execution were to be found in all buildings to the same extent that they have been evinced in this.

STEAM GENERATING EQUIPMENT.

The amount of power generated in this plant, the extensive use of machines driven by direct-connected electric motors, together with the use of all the appliances which go to make up a complete and modern plant make this installation one of the most interesting to the electrical engineer.

The boiler plant consists of eight Babcock & Wilcox 150-hp boilers, and equipped with the Hawley down draft, designed for a pressure of 150 lbs., although it is expected that the working pressure will be only 125 lbs. They are arranged in batteries of two in two sets of four boilers each, as will be seen in the accompanying plan, and each set of four boilers is connected with a Green economizer arranged with a by-pass, so that the hot gases can be taken directly to the stack without passing through the economizers. For artistic considerations it was desirable to avoid the use of a high-stack, and since in the refiner nitrous fumes are copiously produced, it was decided to use an artificial draft. This is produced by a 96-inch Sturtevant fan, driven by an engine at each end of the shaft, arranged so that either engine may be used to operate the fan.

The boilers are supplied by two duplex Barr pumps, and the piping

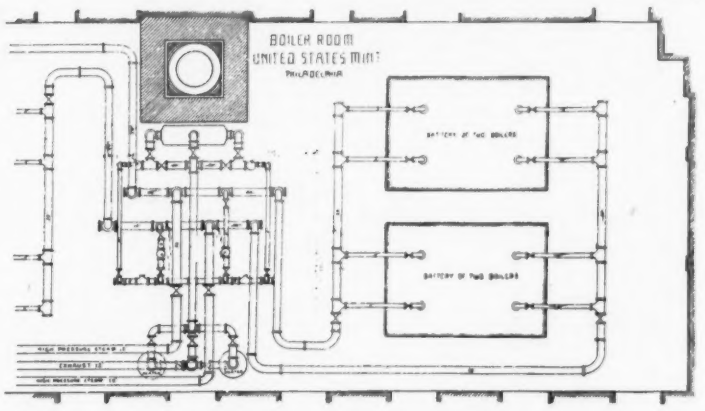


FIG. 2.—PLAN OF BOILER ROOM.

is so arranged that either pump can be used to force water into either end of either boiler. The feed water is heated by a 700-hp vertical exhaust steam-feed water heater arranged with a by-pass and by the economizers.

The steam piping may be considered as made up of three systems—the high pressure, medium pressure and low pressure. The high-pressure system, intended to be operated at 125 lbs., is used to supply the large generator engines. This system is completely in duplicate so as to avoid the chance of a possible breakdown. The medium pressure system, intended to be operated at 70 lbs., is used to supply the small engines and pumps, the reduction in pressure being obtained through a pressure-reducing valve. The low-pressure system is to be used for heating, and is supplied either from the exhaust of the engines or pumps or by means of live steam taken through a reducing valve.

The building is principally heated by the Warren Webster vacuum

system of direct heating. This is supplemented by the ventilating system, which makes use of heated air, which is filtered by being drawn through cloths of close fiber cheviot. The heating apparatus, together with the boiler auxiliaries and the entire plumbing of the building, was installed by S. Faith & Co., of Philadelphia. Among the plumbing features is the arrangement of electrically-driven pumps, by which the various rooms in the building are supplied with both hot and cold water.

POWER PLANT.

The generating plant, the general arrangement of which is shown in the accompanying diagram, consists of four direct-connected slow-speed units. The engines were made by the Edw. P. Allis Company, of Milwaukee, and are one of 100 hp, one of 200 hp and two of 300 hp. They are equipped with new style dashpots, which operate with much less noise than is usual, and permit a higher speed. These engines are erected upon foundations about 9 ft. deep, resting upon a concrete sub-base 12 in. thick. They are guaranteed to give a water consumption not exceeding 23 lbs. per ihp per hour for the smallest size engine and 21.5 lbs. for the largest. The 100-hp engine is intended to cover the night load, and one of the 300-hp engines is expected to serve as a spare unit. Direct connected to these engines are two 200-kw, one 150-kw and one 75-kw Crocker-Wheeler generators designed for 250 volts, and for speeds of 100 r. p. m., 135 r. p. m. and 150 r. p. m., respectively. Their magnet frames are cast iron, and of the internal girder construction, the yokes being divided horizontally. The diameter and face of the commutators are generous in their proportions, and the practice employed by the manufacturers of these generators provides long air-gaps, so that any slight inaccuracy in centering the armature or wear in the bearings affects only slightly the total clearance and, therefore, has but a small effect on the magnetic balance of the machines. The brush-holders are of the well-known Crocker-Wheeler parallel movement type, the brush being clamped firmly in a brass box, which moves radially should there be any movement to the commutator. The holder is so constructed that it will permit any individual brush to be lifted off the commutator and retained in that position, or even be removed and replaced again without affecting the character of its seat upon the commutator face. The current is conveyed from this to the rocker arm by heavy sheet copper links. The brush is, therefore, always perpendicular to the surface of the commutator. The general appearance of these generators will be seen in the accompanying illustration.

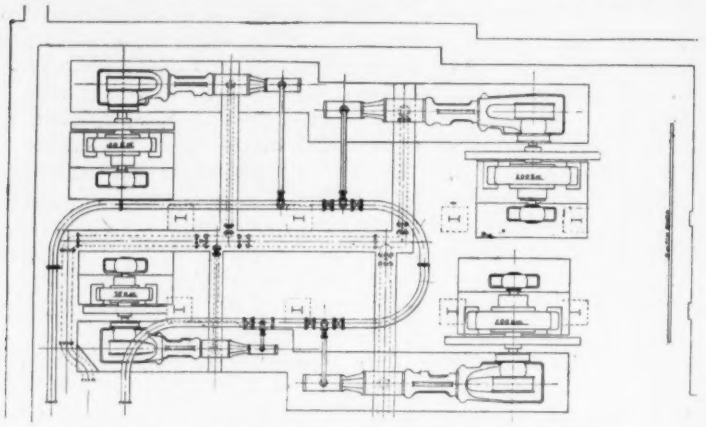


FIG. 3.—PLAN OF ENGINE ROOM, PHILADELPHIA MINT.

MOTORS.

For what may be termed the service of the building, 18 motors, varying in size from 2 hp to 25 hp, and aggregating 300 hp, are used These motors are employed for operating the elevators, fans, pumps, blowers, etc. For the coining operations about 120 motors, varying in size from 1-6 hp to 50 hp, and aggregating about 1000 hp, will be used. The motor installation is not yet complete, but already includes 108 motors, aggregating over 750 hp, furnished by the Crocker-Wheeler Company, and a few of the Keystone and Westinghouse makes. In no other mint has the use of electric power for the operation of machinery been carried to such an extent, practically all of the machines employed in the coinage operations being driven by individual motors arranged especially for geared connection, making very compact and workmanlike equipments.

In the process of coining the metal is first passed through an electrolytic refining process, by which the metal is carried through the solution from the anode to the cathode, producing a deposit of a fineness as great as 999.9. The current for this electrolytic refining is produced by two direct-connected motor-generators, designed to give 500 amperes at 5 volts. The purified metal is then melted and mixed with the proper alloys in order to secure the necessary hardness, and cast into ingots. The ingots are then passed through "topping" machines (four in number), each operated by a 3-hp motor, in order to cut off the rough end of the ingots. They are then rolled out in rolling machines, of which there are six, each operated by a 50-hp motor, and are then passed through the finishing rolling machines, operated by 25-hp motors, from which they come out in flat strips of the proper

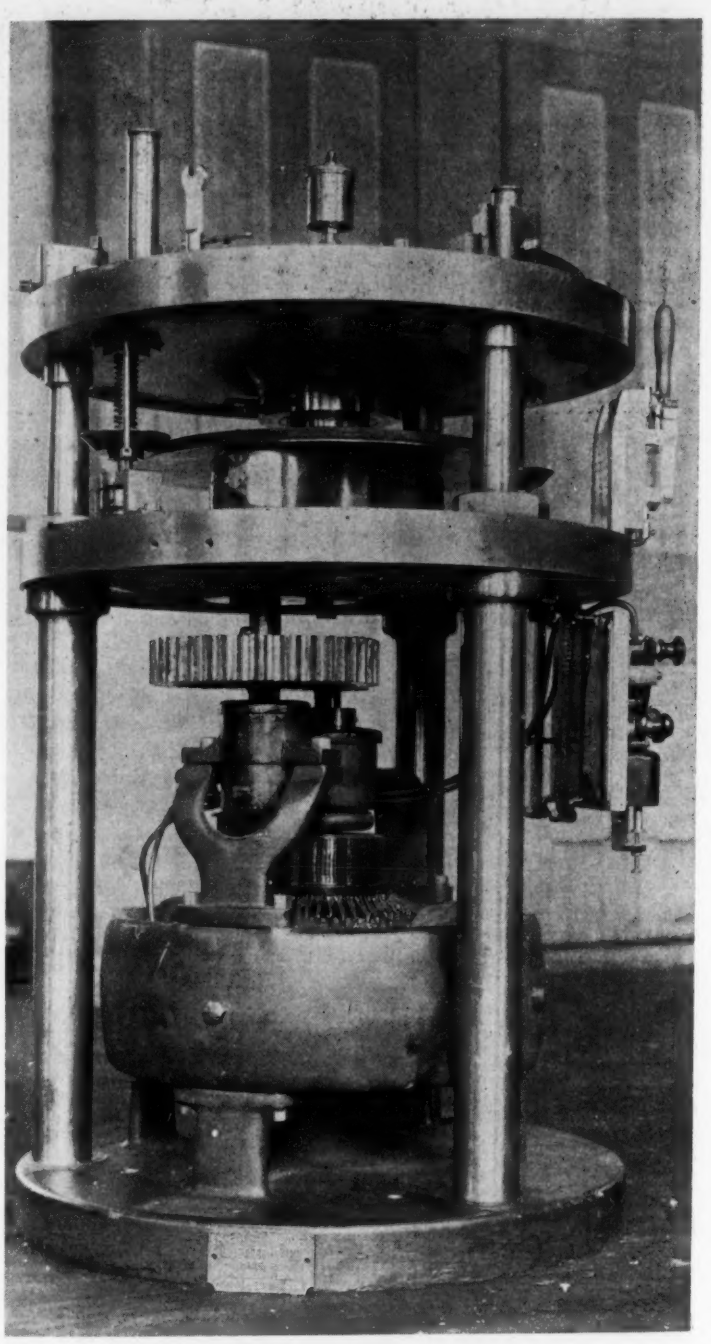


FIG. 4.—UPSETTING MACHINE.

width and thickness. During the rolling process they are annealed at intervals by passing them through the long "strip" furnaces (9 in number), which are operated by ½-hp motors. These strips are then passed through cutting presses, operated by 3-hp motors, and the circular blanks thus produced are carried to extremely ingenious although quite complicated automatic weighing machines. These ten machines are driven each by a 1-6-hp motor, and automatically sort out hte blanks which are too large or too small. The perfect blanks are then carried through several up-setting machines, each operated by a vertical 3-hp motor, and emerge from this with a raised rim or edge. They are then carried through the rotary furnaces, driven by ¼-hp motors, in order to anneal them, and afterwards passed through dilute sulphuric acid to remove the coating produced by oxidation.

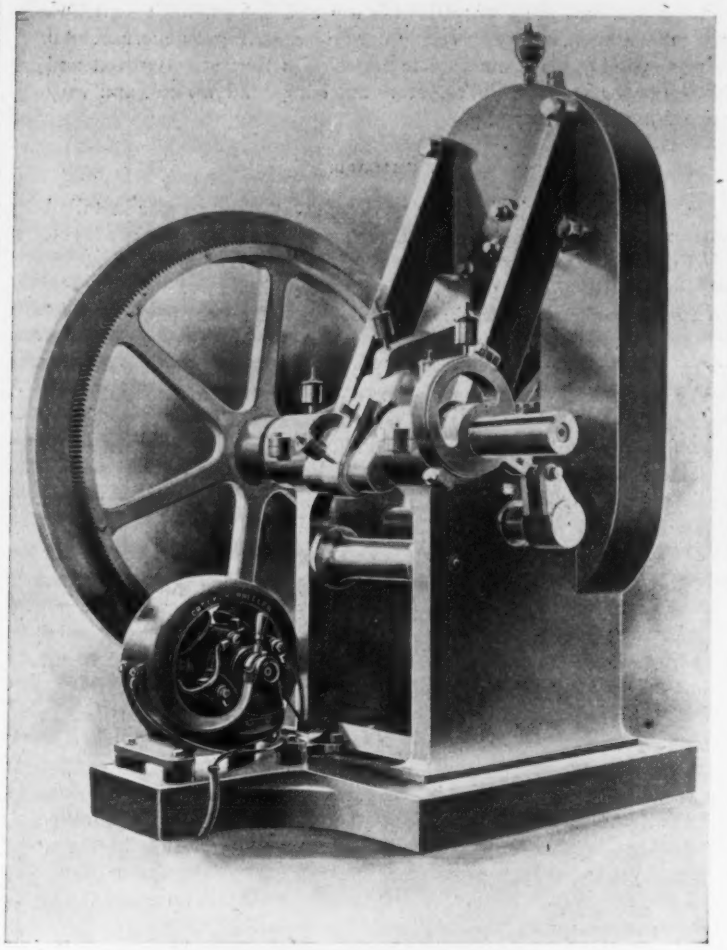


FIG. 5.—ONE OF THE MINTING PRESSES.

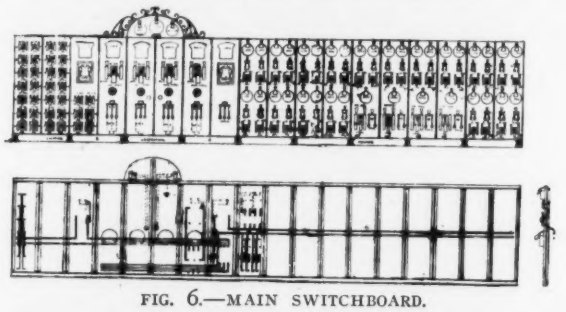


FIG. 6.—MAIN SWITCHBOARD.

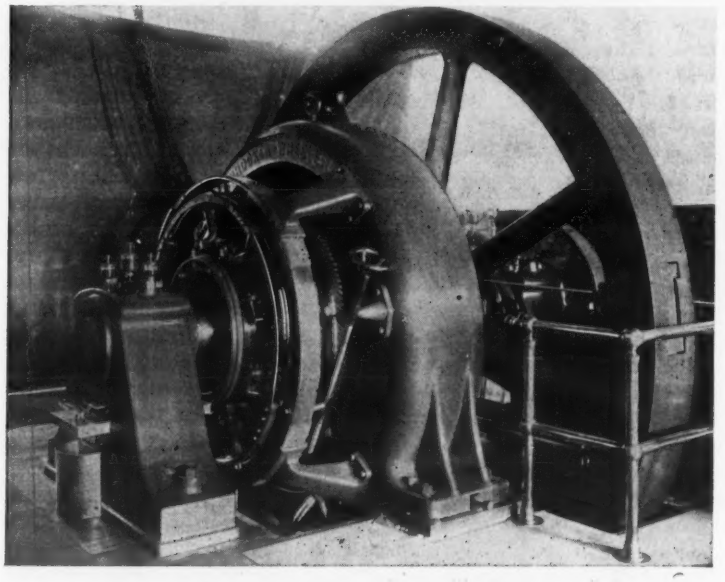


FIG. 7.—ONE OF THE GENERATORS.

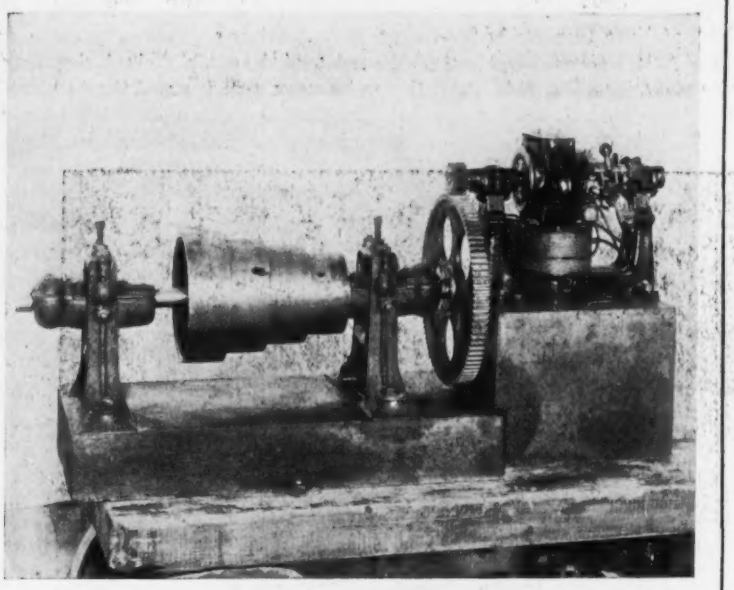


FIG. 8.—GEARED SPEED REDUCER.

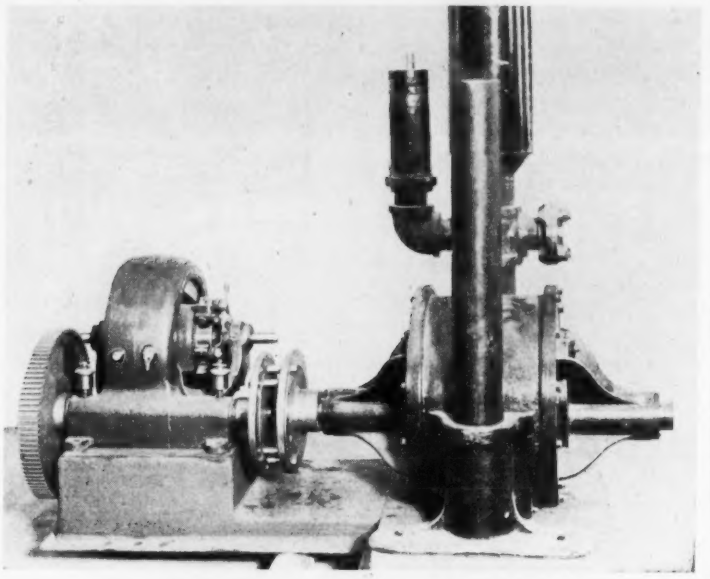


FIG. 9.—HIGH-PRESSURE BLOWER.

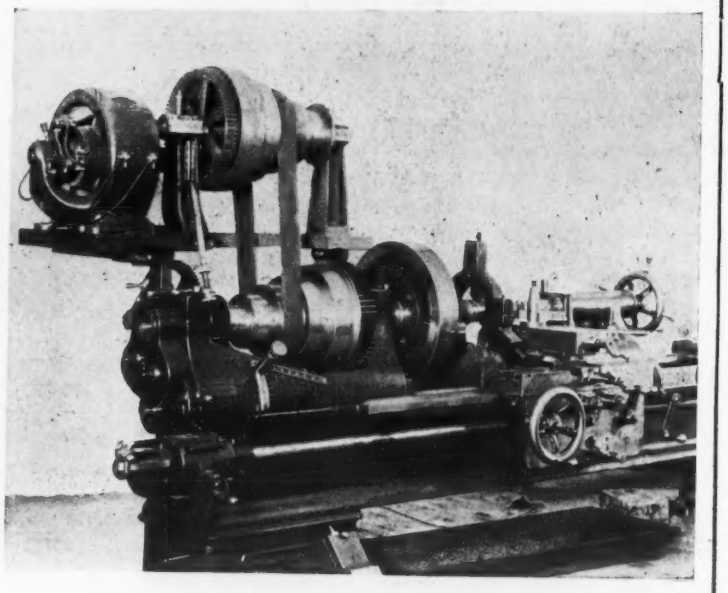


FIG. 10.—MOTOR-DRIVEN LATHE.

THE NEW UNITED STATES MINT, PHILADELPHIA.

All of these small motors as well as the large ones are of the Crocker-Wheeler make. They emerge from this bath clean and bright, and are then ready for the process of coining.

In almost all cases they are of the open type, and in their design and proportions resemble the light and power generators described above.

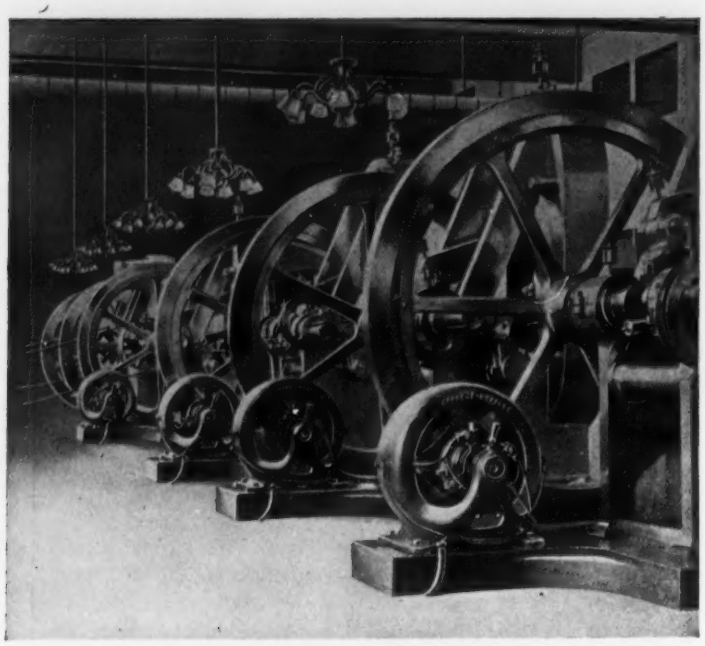


FIG. 11.—MINTING PRESSES.

The coining presses vary in size according to the denominations of the coins. There are 12 driven by 7½-hp motors and 12 by 3-hp motors. The average speed of coining is at the rate of 85 pieces per minute. The total pressure required for the large coins is about 170 tons.

Various methods are employed for connecting motors to the different pieces of machinery, among them being belt-driving, gearing and direct connection. These methods are illustrated in the group of cuts accompanying.

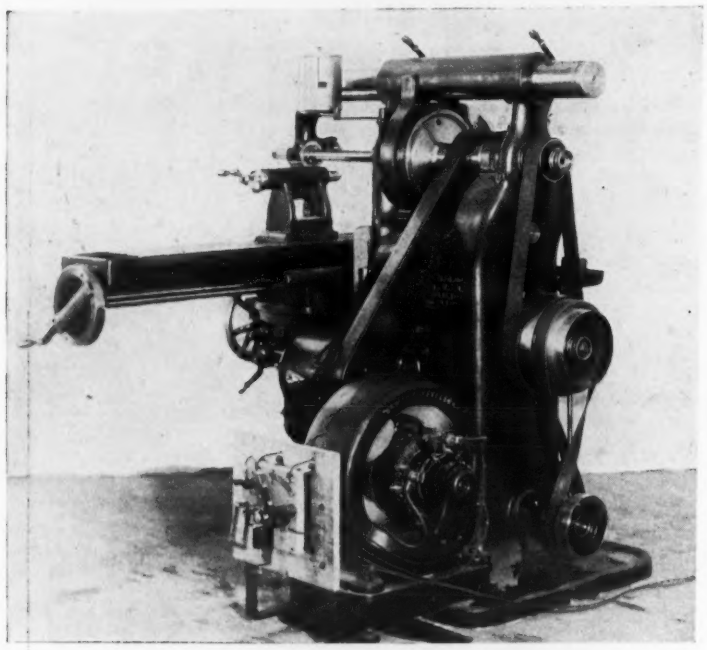


FIG. 12.—MILLING MACHINE.

ELEVATORS.

The elevators in this building form no inconsiderable part of the mechanical equipment. One is used for passenger service, and the other seven are for freight. All were supplied by Stokes & Parrish, and all are electrically driven. They are automatically controlled from the car, and are equipped with top and bottom limit switches, slack cable switch, safety switch in car and centrifugal governor. All of these switches are connected in series with the safety cut-out and with the brake magnet. The motors are compound wound, and vary in size from 30 hp to 50 hp.

SWITCHBOARD.

The switchboard, which is one of the largest among those installed for isolated plants, is made of pink Tennessee marble 2 inches thick, and is divided into 18 panels, four of which are used for the generators, two for the lighting circuits and the remainder for the distribution to the various motors in the building. The board is arranged with two sets of bus-bars; one for the lighting, the other for the power, arranged with a bus-coupler switch, so that the two sets may be connected together or may be run separately, as desired. The generator panels being equipped with double-throw switches, either generator may be thrown at will onto either set of bus-bars. In addition, there is a small connection to the service of the local electric lighting company. The general design of the board may be seen from the accompanying cuts.

The lighting circuits are not provided with switches, for the Cutter circuit breakers on these panels are made with independent arms, and are intended to be used as switches as well as circuit breakers. On the power panels, single-arm Cutter circuit breakers are employed in conjunction with the switches, and each circuit leaving the board is supplied with an ammeter.

One of the Thomson-Houston recording wattmeters shown in the diagram is connected so as to measure the total power distributed from the lighting panels, the other to measure the total power distributed from the power panels. Similarly a Weston ammeter measures the total current flowing from the lighting panels and another the total current from the power panels. The circuit breakers, switches, instruments, and all the metal parts on the front of the board are finished in copper, giving with the marble an exceedingly handsome appearance.

The connections between the generators and switchboard consist of Roebling's lead encased, rubber insulated cables, the size being for the 75 kw, 450,000 cm.; for the 150 kw, 900,000 cm., and for the 200 kw, 1,200,000 cm. These cables are carried in a brick duct covered with the usual iron plate.

SYSTEM OF WIRING.

As will have been seen from the preceding description and diagram of the switchboard, the wiring of the building is divided into two parts, one for lighting and one for power. The latter includes circuits for what may be termed the service motors of the building, such as fans, elevators and pumps, together with the circuits for the apparatus particularly connected with coining. The service motors have each an independent circuit to the switchboard. The motors for the coining processes are arranged somewhat differently, there being 26 circuits to supply the 121 motors used for these purposes. Each of these circuits leads from the main switchboard to a large junction box placed in the floor of the room which this circuit supplies. In this box the circuit splits into two or more branches, passing through the small power outlet boxes, of which there is one for each motor, which it is expected to install, this power outlet box being placed in the floor at a point near the location of the motor. From the lugs in these power outlet boxes, wires are carried to the motors as they are installed. The large junction boxes thus serve as panel boards, but differ from them in that they have no switches or fuses.

The loss of pressure allowed on the motor circuits between the switchboard and the large junction boxes is 6.5 volts, and the same loss is allowed on those circuits supplying the service motors.

The current to supply the 4000 incandescent lights and the 16 arc lights in the building is carried from the main switchboard through beveled glass plate doors complete the artistic appearance of these boards. As there are no local or room switches, each circuit leaving the panel boards is provided with a knife-blade switch, and the entire board may be disconnected from the feeder by the opening of the main line switch. Owing to the use of 220 volts, the system of distances between the metal parts is fixed at 2½ inches and the fuse lengths at 3⅛ inches.

The electric fixtures made by Cassidy & Son, of New York, and Horn & Brannen Company, of Philadelphia, are, in the front portion

of the building, quite elaborate, especially the one in the Numismatic Room.

TELEPHONE SYSTEM.

The building is equipped with a complete local telephone system, having an exchange in the guard's room and 51 instruments located in various parts of the building. The system employed is the complete central energy system of the Western Telephone Construction Company, this energy being supplied by a set of storage batteries in duplicate. Any person desiring to call up central has only to lift his receiver off the hook. This causes the shutter of his trap on the switchboard to fall and calls the attention of the operator to him. The switchboard is of the desk pattern, and is equipped with all the latest devices, such as circuit changing switches, relays, power generator, night bell attachment, etc. Its operation is very rapid and the operator is able to handle all of the calls with ease.

FIRE ALARM AND OTHER AUXILIARIES.

While the building is entirely of fireproof construction, yet in order to protect the costly machinery, it was deemed advisable to install a system for indicating the location of any small fire which might occur. The system consists of an ink-writing recorder, similar to the ink-writing telegraph register, connected in series with two mechanical gongs and with 30 alarm boxes, these boxes being distributed in various parts of the building. One of the gongs is placed in the engine room, and the other in the superintendent of machinery's office, while the register is placed in the guard's room. The call boxes are similar to those of the Western Union or American District Telegraph Company, and when the handle of one of them is turned it causes the number of this box to be recorded five times on the tape of the ink-writing register and simultaneously the two gongs strike the number of the station or box. This system is also operated by storage batteries, and the apparatus for it, as well as the telephone. together with some city fire alarm and police signal apparatus, is mounted on the switchboard shown in the accompanying cut. This board is of blue Vermont marble, 5 ft. by 7 ft. in size, and is mounted on an iron framework. It carries the fuse blocks, the telephone wiring, the fire-alarm recorder, the American District and Western Union call boxes, the police telegraph and city fire alarm boxes, and a voltmeter and a voltmeter switch for testing the condition of the

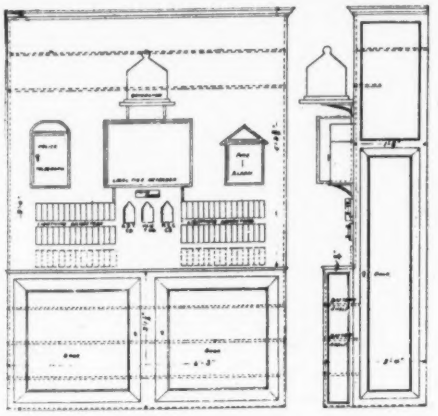


FIG. 13.—FIRE-ALARM SWITCHBOARD.

various storage batteries, which supply the electrical apparatus in the building.

A system consisting of an Eco Watchman's Time Detector, located in the guard's room, and 30 stations placed in various parts of the building, insures the faithfulness of the watchman. The signals are given on the clock by the watchman turning a handle at each station, which causes a small magneto placed in each station box to send a current through the proper magnet at the clock.

As the Mint is essentially a large factory, it is important that the rooms should be supplied with accurate timepieces, and it was, therefore, decided to install a system of secondary clocks operated by a master clock. The clocks employed are 51 in number, and are made by the Standard Electric Time Company. The current for operating them is supplied by a set of storage batteries in duplicate.

STORAGE BATTERY.

A complete storage battery in duplicate, furnishes energy for the operation of the telephone exchange and fire-alarm systems and the time clocks. This battery consists of 60 Electric Storage Battery Company's cells No. 5-C. These cells are placed in a special room in the attic, and are connected to a circuit-changing switch, so that when the switch handle is thrown in one direction 30 of the cells will be thrown in series and made ready for charging. The other 30 are split up into five groups with a different number of cells in each group, one supplying the telephone exchange, another the fire-alarm system, the third the gas machine, and the fourth and fifth the time clocks. Whenever these cells have been sufficiently discharged, the circuit-changing switch is thrown in the other direction, throwing the duplicate set of batteries in connection with the various pieces of aparatus above-mentioned, and the first set in series ready for charging. The cells are charged from one of the circuits on the power panels through an ammeter, circuit breaker and rheostat, the general arrangement being shown in the diagram.

The electric equipment for lighting and power, from the generators

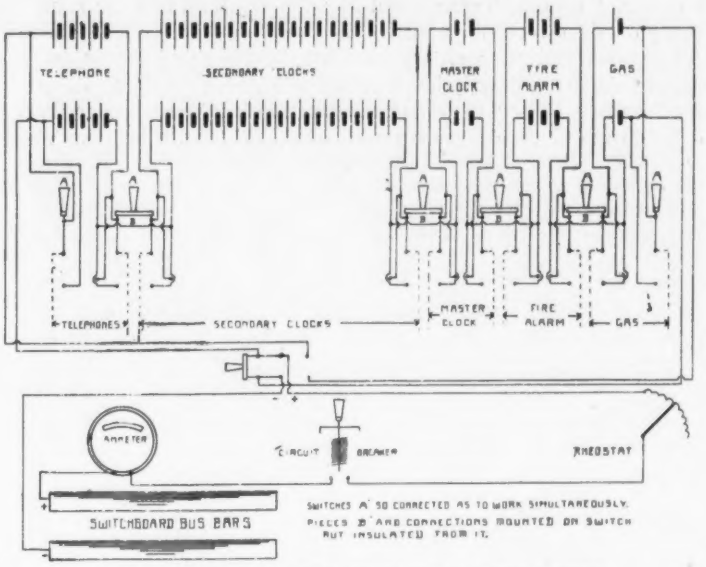


FIG. 14.—DIAGRAM OF STORAGE BATTERY CONNECTIONS.

to the outlets, together with the telephone, time clocks, watchman's detector and fire alarm systems and the storage battery was installed by Messrs. Keller, Pike & Co., of Philadelphia.

Cables at Constantinople.

An item from Constantinople states that outside the terminus of the Oriental Railway at Stamboul stands a bridge, crossing the line. Beyond this the line is single, and to avoid accidents a somewhat complicated system of signals has been established, working by electricity. The wires, over 40 in number, are inclosed in three subterranean cables, and beyond the bridge there are two lightning conductors. On the 15th day of Ramazan the Sultan has to go to Stamboul to kiss the Prophet's Mantle, and the route he takes is always kept a pretended secret, though for several years past he has always gone by sea. There is, in fact, very little probability of his ever going by any other route again; but, were he to choose, he might have to pass over the bridge in question. This year his attention was called to the fact of electric cables running under the bridge, and orders were immediately sent to have them taken up. It was pointed out that the most serious danger might be incurred by disorganizing the signal system, and that the cables could not be disabled without a substitute being furnished, which would take time. All the concession that the Palace would make was that the cables might remain if they were dug up and exposed on either side of the bridge. Consequently, there are now two curious excrescences on the permanent way, where the cables have been disinterred and are exposed to view —an instructive lesson to visitors of the degree of enlightenment to which Turkey has attained in the twentieth century.

Wireless Telegraphy to the Farallon Islands.

Alexander G. McAdie, Forecast Official of the Weather Bureau, San Francisco, is making preparations for the operation of wireless telegraphy between the Farallon Islands and Pt. Reyes, on the California coast, 30 miles north of San Francisco. Permission was recently granted by the Washington authorities for the use of those locations. Plans have been prepared for a mast 150 ft. in height to be erected on South Farallon Island.

Electric Equipment of Railway Docks, Middlesborough, England.

One of the most important fields of modern electrical power work is the equipment of docks. In New York City the idea is not a new one, but was taken up in the earliest days of the electric motor; the fact still remains, however, that very few of the docks around Manhattan Island enjoy the facilities that are furnished by electricity for the quicker handling of freight and cargoes. In Europe meantime, considerable work of this character, as elsewhere in America, is being done, and we are glad to be able to illustrate a fine plant just finished at Middlesborough, England, for the Northeastern Railway Company's docks. This plant comprises no fewer than 17 3-ton jib cranes, 3 10-ton jib cranes and 24 1-ton capstans, and the results already obtained more than justify the equipment.

The 10-ton and 3-ton cranes are virtually the same, except as to size, and the 3-ton description will suffice for all that class of apparatus installed. The 3-ton cranes are 60 ft. in height from quay level to the jib top pin, and have a radius of jib of 44 ft. 9 inches. The

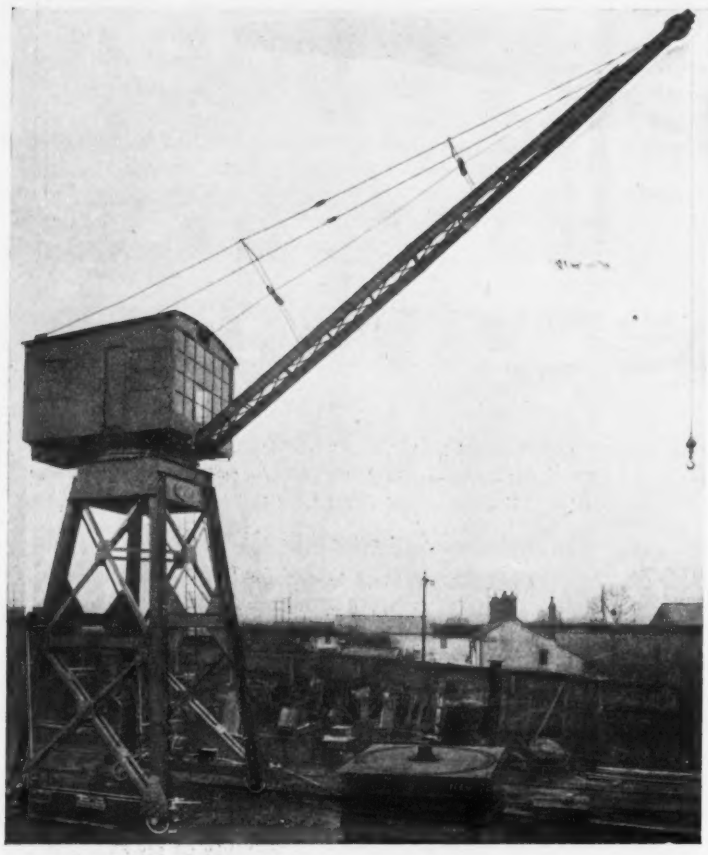


FIG. 1.—ELECTRIC CRANE.

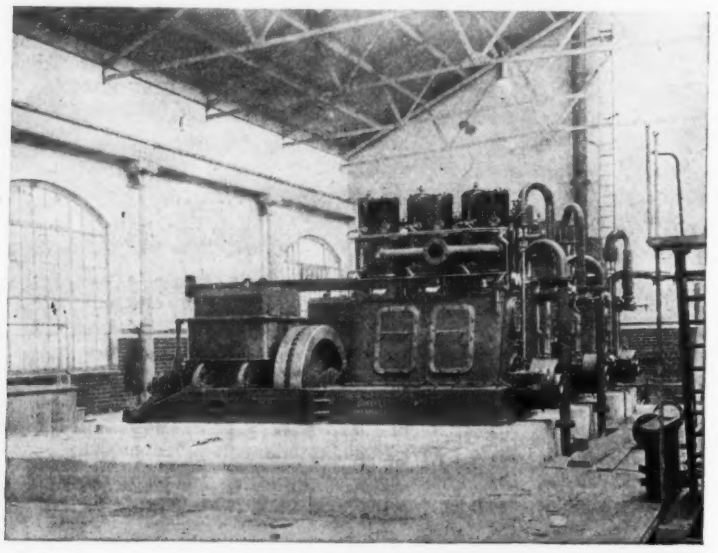


FIG. 2.—GENERATING PLANT.

revolving speed at the hook is 400 ft. per minute, and the travel speed is 30 ft. per minute. The rate of lift with three tons is 150 ft. per minute, or 250 ft. with 1½ tons.

The crane is of the high gantry type, with gantry 30 ft. high, admitting the passage of wagons and engines underneath. The large radius of the crane enables it to cover five lines of rails and minimizes delays caused by shunting. The bottom framing of the gantry is composed of two channels, tied together by plates, and riveted up so as to form an open box-shaped girder. The trod wheels are of cast steel, with double flanges, and keyed on steel spindles running in cast iron plummer blocks bushed with brass. The traveling gear motion is fitted with both hand and electrical gear. The electrical gear consists of an enclosed series-wound multipolar motor, which is coupled to a steel worm working into a delta metal worm wheel. The power is communicated to the trod wheels by means of spur and bevel gearing, the wheels on each side being coupled together by means of a cross shaft, thereby ensuring uniformity of movement and avoiding any twisting strain on the gantry. Hand gear is fitted in addition. Upon actual test it has been found that the time taken to release the rail clips and jacks, travel 30 ft. and refix the clips and jacks is about three minutes. This time includes removing and reinserting the plug connection in the next connection box.

The switch gear for the traveling motor is placed in a water-tight case upon the bottom framing of the gantry, and the switch is provided with a detachable key, which is kept in the crane cabin, and is in charge of the driver. The four uprights are compound steel girders set at an angle which gives the form of a pyramid. Holding-down clips for fixing to the rails, and screw-down jacks for increasing the base when the maximum load is being dealt with, are also provided; but it has been found that the cranes are absolutely stable at all loads up to a considerable overload even without these attachments.

The revolving frame is composed of two H-beams tied together by stretchers and having a cast iron center piece through which the center pillar is taken, and upon which is fitted a grooved steel ring, provided with a series of case hardened balls. The collector is fitted to this pillar, and consists of two copper rings mounted upon ambroin and separated by rings of the same material. The collecting brushes consist of two gauze straps, each encircling one ring, the tension being regulated by springs. These straps are attached to terminals, which in turn are mounted upon porcelain insulators. The crane cabin is of teak, and the front consists of a wrought iron framing glazed to enable the driver to have his work in full view. It contains the lifting and slueing gear and the controlling apparatus.

The lifting gear consists of a barrel, wheel and pinion. The wrought steel pinion is forged solid upon a shaft which is fitted with a half coupling to meet that upon the motor spindle. Upon this shaft there is a band brake actuated by an electromagnet, which will be described later. The pinion gears into a cast iron spur wheel keyed on the barrel shaft. Both pinion and wheel have machine cut teeth, and work in a cast iron gear case, which forms an oil bath. The lifting is done on a single flexible wire rope. The barrel is of cast iron turned and grooved to receive the rope, and is large enough to take the full lift without overlapping. The barrel shaft is carried on cast iron brackets, the bearings being brass bushed, and the whole is mounted upon a cast iron bedplate in conjunction with the motor.

The lifting motor is designed to give 50 hp at 300 r. p. m., and is of series enclosed four-pole type, with slotted armature and carbon brushes. It is completely enclosed and rendered water and dust-proof by means of cast steel end plates. The revolving gear consists of a motor worm, worm wheel and spur gear. The worm is forged solid on the shaft, which in turn is fitted with a coupling to meet the motor. The worm engages with a delta metal worm wheel, and a pinion keyed to the worm wheel shaft engages with a spur wheel which is fitted to a short shaft actuating a pinion. This pinion travels round the rack of the crane and thus slues the cabin and jib. A brake, actuated by a foot treadle, is fitted to the first motion spindle, so that the slueing motion is always fully under control. The slueing motor is of similar type to the lifting.

The electric brake magnet referred to above offers some points of interest. It is placed in series with the armature of the lifting motor, and consists of a horseshoe magnet (with poles arranged as those of a two-pole dynamo) with a solid steel armature of special shape

capable of revolving between them. The passing of the current round the field coils tends to move the armature through a right angle. A lever is fixed to the end of the armature, and the brake, which is normally held on to the brake wheel by a weight, is connected thereto by a rod. The movement of the armature lifts the brake and releases the brake wheel. The great advantage lies in the strong pull and long range. The brake is also connected to a lever which stands at the driver's left, so that the brake can be operated by hand instantly when required.

The controller consists of two separate controllers combined in one case and actuated by one handle. One controller actuates the lifting motion and the other the slueing, and both are connected by pinions and quadrants to the lever. The latter is so arranged that when moved in a vertical plane it actuates the lifting and in a horizontal plane the slueing controller. Thus it will be seen that the hook follows the motion of the driver's hand, lifting when he raises the lever and so on. One particularly conspicuous point about the controller is the ease with which it is manipulated, owing to the absence of click gear upon the intermediate contacts. Notches are provided only at the two extreme and the off positions, and in consequence the controller may be operated by the driver throughout the day without fatigue and its attendant slackness. The resistances are fixed inside the crane cabin. The switchboard consists of polished slate, framed in teak and fitted with automatic cut-out, lifting and slueing isolating switches, fuses and lighting switches. The crane cabin is well lighted by fixed and portable lamps, and a cluster in an enamaled iron reflector is fixed beneath the jib. Terminals are provided upon the switchboard to which may be connected a registering voltmeter and ammeter.

In addition to the cranes 24 capstans have been provided for handling trucks. These are electrically driven, and are capable of exerting a steady pull of one ton at a speed of 200 ft. per minute, or of hauling a load of 100 tons along a level road. The capstan head is driven by a cast iron spur wheel, which is engaged with a steel pinion. The latter is keyed on the same shaft as a brass worm wheel.

The driving worm is forged solid upon its shaft, and is coupled direct to the motor spindle. The worm and wheel work in an oil bath. The motor runs at 1000 r. p. m., and is completely enclosed. In construction and design it is similar to the crane motors, but it is shunt wound to avoid large variations in the speed of the capstan head. Upon the motor shaft there is fixed an automatic mechanical brake, which, when the capstan head is driven by the motor the brake releases itself automatically, but should the capstan tend to run back through being overhauled by the weight the brake at once locks itself and sustains the load. Such a brake is absolutely necessary upon an electric capstan, as it differs from a hydraulic capstan in one important respect, viz., that in the hydraulic the water in the cylinder holds the load, whereas in an electric capstan there is nothing to sustain the load upon the current being cut off, and if the load is allowed to run back a serious accident may ensue. It is also essential that the brake should be automatic, so as to claim none of the driver's attention from his work.

The electrical switch gear presents many points of interest. It consists of a controller with magnetic blowout and with overload release gear. The controller is worked by a pedal projecting above the capstan case by about 4 inches. This pedal is removed when the capstan is out of use. The pedal is connected to a dashpot, which prevents the controller being operated too rapidly when the driver is starting the capstan, but at the same time by means of valves in the plunger allows the controller to return rapidly to the off position. The return to the off position is effected by means of a weight, which is lifted as the pedal is depressed. In the event of the capstan being pulled up by sudden overload the release gear works instantaneously and breaks the main circuit. Upon the pressure being removed from the pedal the return of the controller to the off position automatically replaces the release switch and the capstan is ready to start again. The whole of the gear is contained in a water-tight cast iron case sunk in the ground, the top of which consists of chequered plates flush with the quayside.

The distribution of current is effected by a network of feeder and distribution cables laid below ground. These cables are fiber insulated and lead sheathed. They are laid in wooden troughs in a mixture of sand and tar, and are at a depth of about 2 ft. from the surface. Water-tight junction boxes are provided at the junctions of the feeders. The crane connection boxes are in two portions, the bottom of which contains the positive and negative distributing cables, and the top the connection apparatus for the cranes. The distributing cables pass through the lower portion, and a connection is taken from each by means of a T-joint to the upper portion. At the same time two cables are taken off to the nearest capstan. The whole of the lower portion is filled in with bituminous compound. The upper portion of the box contains two fuses and the crane connection contacts. Both contacts and fuses are mounted on porcelain insulators, and are completely shielded from damp. The top of the box consists of a chequered plate, with a circular aperture to receive the connection socket. When the box is not in use a water-tight steel cap covers this aperture.

The connection socket consists of a circular gun-metal hood, which accurately fills the aperture in the cover of the box, and is so shaped as to completely shield the joint from wet. The interior of this hood contains two gun-metal tongues, which meet the two clip contacts in the interior of the box. A stud and groove insures that the socket shall enter the aperture only in the correct position. The flexible crane cable enters the hood of the socket through a trumpet mouth, and the whole apparatus is shaped so as to obstruct the quayside as little as possible. There are 52 boxes in all, placed 20 yards apart. They have stood the test of the severest weather, and have given no trouble.

The power plant consists of four Siemens-Belliss sets of generating units of which three are together equal to running the complete installation, of which the whole electrical part was furnished and put in by Siemens Brothers & Co., Limited, of Woolwich, England. The dynamos are Siemens' two-pole type, and are designed to give each 240 kw at 400-430 volts. They are coupled direct to compound engines by Messrs. Belliss and Morcom, and designed to run at 380 r. p. m. The switchboard is of marble, and consists of four machine

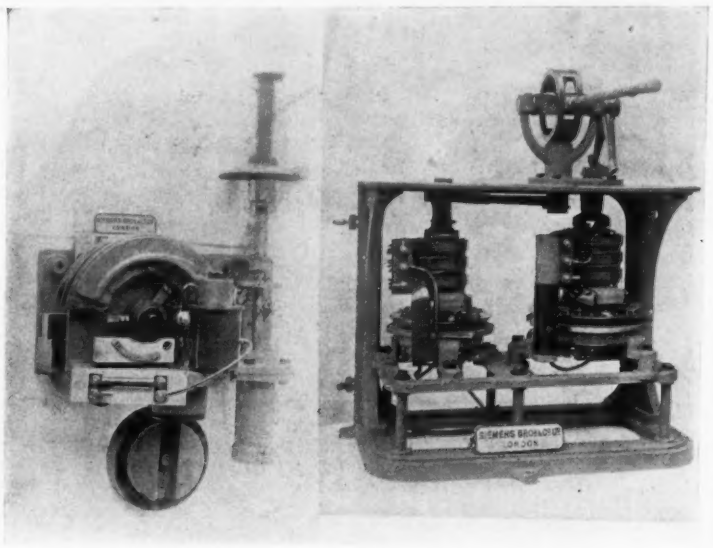


FIG. 3.—CRANE CONTROLLER.

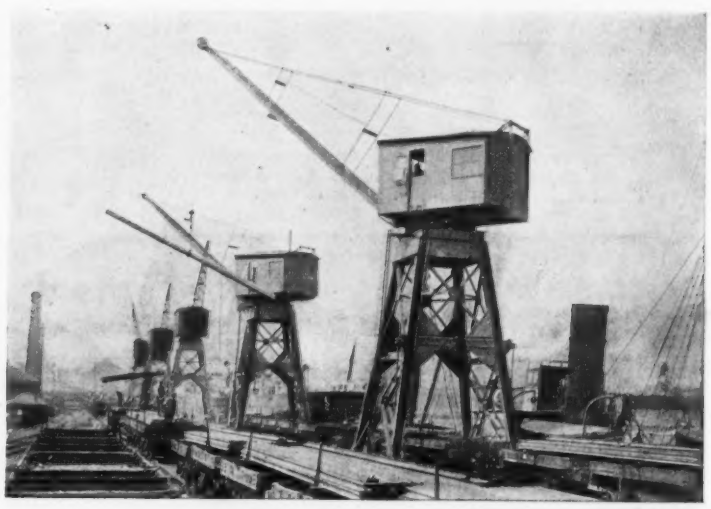


FIG. 4.—ELECTRIC CRANES.

and one feeder panel. The instruments are of the Siemens' moving coil type. The shunt winding of each dynamo is brought to a switch on the board, and these shunt switches are interlocked with their respective main switches, so that it is impossible to break the exciting circuit of any machine until the armature has been cut out of circuit, nor can the armature be thrown in until the shunt circuit is made.

FIG. 5.—ELECTRIC CAPSTAN.

The four machines are run in parallel upon the bus-bars, and the shunt circuits are excited from the bars. An exhaustive series of tests upon the three-ton cranes shows that the electrical energy consumed in one complete cycle of evolutions at full load is roughly .17 unit or 170 watt-hours. With a fairly skilled operator the cranes make 45 complete "cycles," or operations under load, in an hour.

A Portable Quad for the International Yacht Races.

BY JOHN F. SKIRROW.

FIG. 1.—PORTABLE QUADRUPLEX.

IN making preparations for handling the volume of press matter consequent upon the recent international yacht races, it devolved upon the writer to design and install an outfit of quadruplexes to increase the Postal Telegraph Company's telegraph facilities at the Highland of Navesink, New Jersey, the marine observation tower at that point being the principal station from which the newspaper bulletins describing the races were transmitted. This tower is regularly used in connection with the marine service reports of the arrival of vessels at the port of New York.

It has been common practice where an emergency necessitated the installation of temporary quadruplex equipment to set up gravity battery, or to connect motor transformers with some available power circuit to obtain the required voltage and the grounded battery currents necessary in the operation of quadruplex telegraphy, and to wire up such multiplex apparatus as was required on the spot.

The large number of cells requisite for the desired pressure and the lack of the necessary space for its erection, precluded the use of the former method in this case, while the entire absence of any source of electrical supply or available prime mover, at or conveniently near to the Highlands, prohibited the latter plan. It was decided, therefore, to install an "explosive" engine, dynamo and transformers in the room at the base of the observation tower to operate the quadruplexes. This part of the outfit consisting of a 1-hp Mietz & Weiss kerosene engine, belted to a 1-kw generator, which in turn operated three Perret motor transformers, converting from 110-volt primary to 360-volt secondary, furnished the necessary currents very satisfactorily.

In developing the plans for the operation of the outfit it was deemed advisable to do all possible wiring and construction at headquarters in New York prior to shipment, on account of the somewhat inconvenient location at which the plant was to be operated, the observation tower being located near the crest of the Highlands, close to the famous Twin Lights and some distance from a roadway. The result was the construction of a somewhat unique portable telegraph plant.

Instead of wiring up the instruments at the Highlands, therefore, the quadruplex sets, three in number, were placed in specially designed cases. These cases when closed present an appearance somewhat similar to an ordinary packing case with a handle upon each end. When opened by raising two of the lids and lowering the two others that form the sides of the case, a complete quadruplex operating table and outfit is disclosed. This is placed upon a collapsible framework, which takes the place of table legs.

All of the numerous switches, transmitting and receiving instruments, adjustable rheostats, condensers, resistance coils, etc., etc., that are used in connection with a quadruplex, including those ordinarily placed behind the switchboard in a telegraph office, are secured firmly in the case with permanently wired connections. This arrangement

FIG. 2.—MARINE SIGNAL TOWER.

requires but six terminal binding posts for the connection of extraneous wires to the case, viz., the line wire, ground wire, two local current and two main line current feed wires, the quadruplexes being operated upon the "Field" system, which requires but two main line dynamo pressures.

The local 20 ohm sounder circuits are fed through 500 ohm resistances from the main 110-volt generator, each circuit thus receiving about .2 of an ampere. These sounders are placed in resonators, which are swiveled upon arms so that they may be drawn out close to the operator's ear, or placed in any desired position. Each case is illuminated by six small series incandescent lamps, connected across the local current leads, using a total of .4 of an ampere of curent. A clock for use in recording the time of transmission and receipt of messages is provided, as also are filing hooks for the unsent and sent business, and a closet which holds a supply of message blanks. Upon occasion these units have been changed from their closed "ready to ship" form and placed in active operation as full quadruplexes within five minutes, and have been taken out of service and made ready to ship, within the same brief space of time.

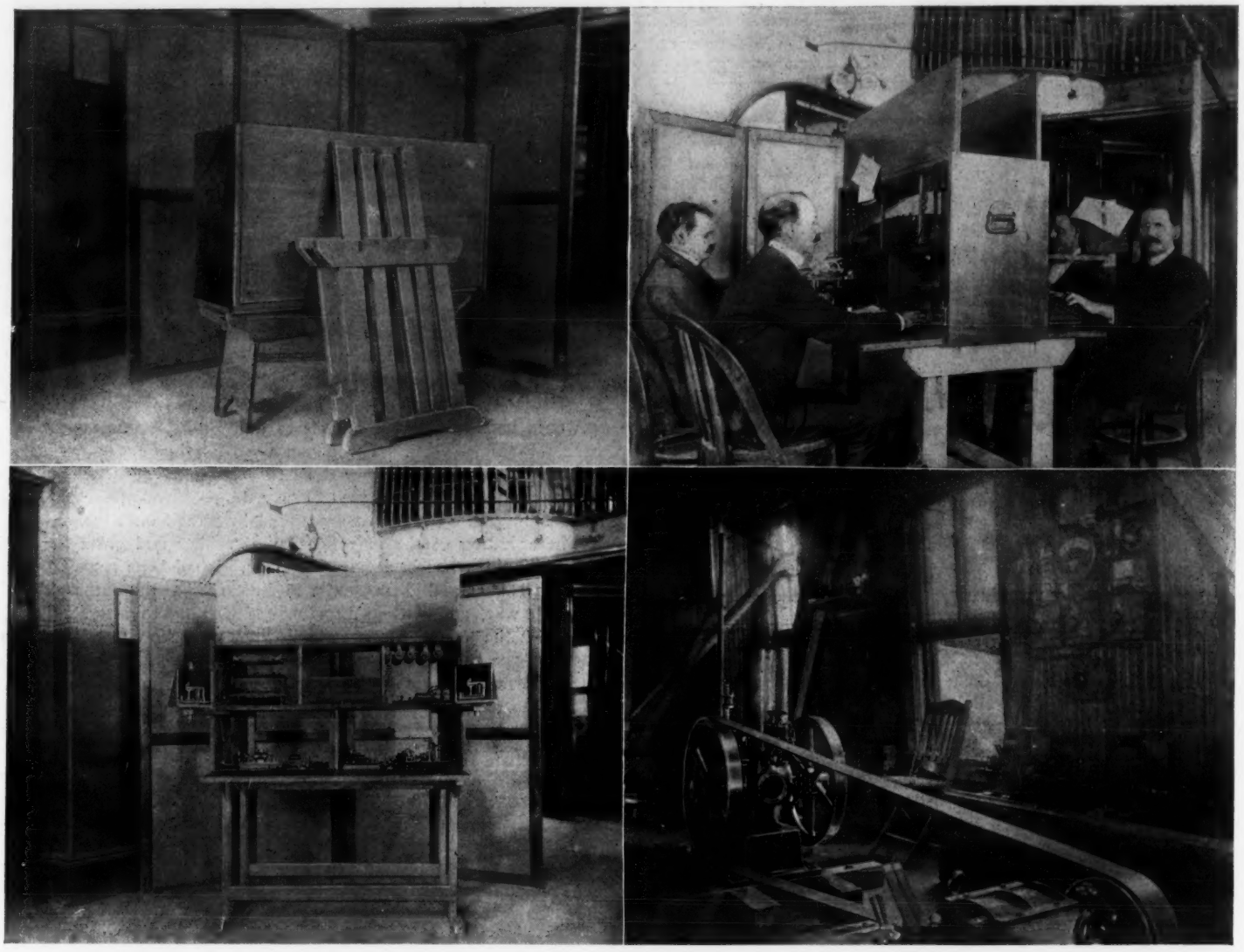
A set of repeaters and half-repeaters, known to telegraphers as "jiggers," is encased in a similar manner, and forms part of the outfit, their purpose being to automatically repeater single "Morse"

circuits into the quadruplexes, where such service is required. The motor transformers are encased in stout pine boxes, each machine being secured to the inside of the lid of its box, in such manner that when this lid is swung open and back against the side of the box, the box forms a supporting bench for the transformer while in service.

The switchboard upon which is mounted an ammeter, a voltmeter with radial switch to all machines, the starting boxes of the transformers, and all the controlling switches, is fitted to slide snugly into an oak case. All connections on this board are brought to binding posts upon the sides and bottom of the board, and are numbered. The transformers are also permanently wired to posts upon their lid bases, which are numbered to correspond with the switchboard posts.

Each transformer case contains a set of wires with connection tips soldered upon each end, so that it is a matter of but a few minutes to connect up the transformer and switchboard outfit, ready for operation. The main dynamo is mounted upon a substantial pine base, and has its field rheostat secured upon one side of the frame. A heavy pine box cover, which may be removed or attached in a minute, encloses the entire machine and is secured to the base. The engine is fitted snugly into a box made of 2-inch pine, the upper part of this box forming a chest in which is carried a complete outfit of such tools and supplies as are required in connecting up and running the engine. This engine case is mounted upon truck casters, and can be readily handled by two men. The exhaust and other pipes are coupled in short lengths and are also boxed. The water cooling tank is crated, and carries a reel of 150 ft. of hose for use in filling the tank, etc. Folding chairs are also provided and shipped with the outfit.

This plant had been shipped to the Highlands and connected ready for operation when the McKinley tragedy at Buffalo occurred. At 4.30 on the following Saturday afternoon it was decided that the Canton (Ohio) office of the Postal Telegraph Company needed the outfit, less the engine. At 6 o'clock the outfit left the Highlands by express, arriving at the Canton office on Monday morning. The outfit was put in operation, giving an equipment of 12 circuits upon three wires in less than an hour's time, and was withdrawn from service at midnight the following Thursday after the late President's interment. Thirty minutes later it was ready for reshipment, and left by express for the Highlands before 10 A. M. on that (Friday) morning The following Tuesday the plant was again in service at the Highlands, and was continued until the conclusion of the series of yacht races, being reshipped to headquarters the day following the final race. One of the quadruplex and repeater units is in an Eastern city in emergency use at the time of this writing, having been placed in service within an hour after its receipt at the office in that city.

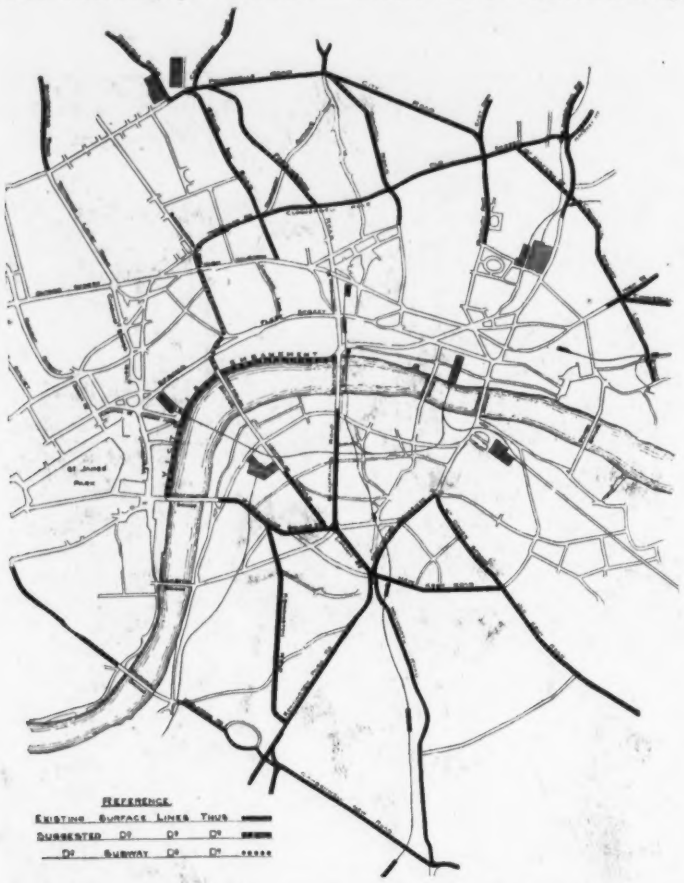


FIGS. 3, 4, 5 AND 6.—PORTABLE QUADRUPLEX IN OPERATION.

The complete plant ready for shipment weighs about 2200 lbs., the engine alone 800 lbs., and the quadruplex units 160 lbs. each. The consumption of fuel used (kerosene) averages 4 gallons per day of 10 hours' service. The load carried at 110 volts on the main dynamo averages 700 watts. Of this the lights take 1¾ amperes and the local circuits 3 amperes, the transformers, of which but two are operated the third being an emergency spare, using up the balance. The outfit is held at headquarters ready to ship immediately to any point. It is particularly adapted to use in quickly establishing emergency offices, such as are required in the event of fire, floods, political conventions, athletic and sporting events, and for military camps. Such an equipment would have been invaluable at the time of the Johnstown and Galveston disasters, or during the Spanish-American war.

Proposed Surface and Underground Electric Road for London.

With reference to the numerous items that have recently appeared in our columns touching the development of electric railway work in and around London, we note that Messrs. Alfred Baker, tramways manager, and John H. Rider, electrical engineer, of the London County Council, have now made a report on tramway subways, etc., for the British metropolis, based in no small measure upon their investigations last year in the United States. They believe that a great advance in the solution of the transportation problem of London will be made if the tramways north and south of the River Thames are linked together, and a plan is presented, showing the proposed extensions under the city and along the river of the subway. Estimating a four-track subway to cost one-third more than a two-track subway,



LONDON COUNTY COUNCIL TRAMWAYS AND PROPOSED SUBWAYS.

the cost of the Boston subway is given in the report at about £425,000 per mile for a two-track subway, and the New York Subway at about £350,000 per mile for a two-track subway. The latter figure, they say, may be considered as a rough guide for a large portion of the proposed subway work in London, given at about £282,000, which, however, does not include the sum for the proposed vault cellars and further vested interests, or the addition of pipe galleries to the subway. The report includes an addendum by J. Allen Baker, chairman of the County Council and vice-president of the highways committee, strongly urging the construction of the subway suggested in the report prepared. A map is given herewith of the plan as noted above.

British Trade in 1901.

Full details of Great Britain's foreign trade in 1901 show decrease in merchandise imports, for the year, of £836,177 from the year preceding, and decrease of £6,028,022 in exports. Reduced to American values, and compared with 1894, the lowest record in recent years,

	Imports.	Exports.	Excess imp.
1901.....	£522,238,986	£348,345,732	£173,893,254
1900.....	523,075,163	354,373,754	168,701,409
1894.....	408,344,810	273,785,867	134,558,943
1890.....	420,691,997	328,252,118	92,439,879
1880.....	411,229,565	286,414,466	124,815,099

imports in 1901 increased $565,000,000, exports $370,000,000, and excess of imports, therefore, $105,000,000. The above is a comparative table.

Gutta Percha in the Philippines.

By Major J. Orton Kerbey.

THE Spanish war changed the direction of the rubber and gutta percha exploitation. My explorations of alto or hyper Amazonian rubber fields early developed the fact that there were untold millions of acres of virgin rubber forest, and that in the foothills of the Andes gutta percha was to be found. But there may also be rubber and gutta forests in the moon.

The inaccessibility and distance of 3000 to 4000 miles from the Atlantic seaport and the scarcity of labor render these virgin forests practically useless, for to exploit them would add so considerably to the first cost of rubber as to make the effort uncommercial.

To the difficulty of finding laborers in that far-off region and the refusal of outsiders to risk their lives in the malarious rubber swamps may be added the heavy expense of canoeing the cargo long distances on the affluents to few settlements on the Amazon reached by steamboats, which in turn demand freight charges on 2000 to 3000 miles of the river, four-fold greater than the ocean freight rate from the seaport to New York. It should be remembered that the best and most abundant rubber, known in commerce as Para rubber, has to come as far to reach Para as from the latter seaport to New York.

This arises from the fact that the most accessible sources of supply on the lower Amazon, and the principal tributaries have diminished because of the increased demand resulting from the requirements for tires, tubing and belting, and electrical insulation.

It was my official reports published specially by the State Department a year after I had left my consulate to go on my first exploration, which called attention to the question of a future source supply of rubber and gutta percha being necessary. The suggestion of a conservation of present forests and of cultivation were opposed by the rubber combine and the Brazilian Government officials as pessimistic—but all the predictions have since been fully verified.

In a business way the time required for transportation and freight rates from the upper Amazon to New York is perhaps greater than it would be from the Philippines to San Francisco or the Isthmian canals to New York. The advantage of a home product of this valuable tropical export would be to encourage the development of our own possessions, and also to save the payment of the exorbitant export duty of 25 per cent demanded by Brazil on rubber.

The agitation of the investigation of rubber and gutta percha in the Philippines was in a way accidental. I had been engaged in exploiting rubber and gutta percha in Amazonia at the outbreak of the Spanish war, and was in London endeavoring to interest English capital in the Peruvian concession. They were slow to take it up because of the bad reputation of Peruvian bonds. At breaking out of the Spanish war I sacrificed my interests to return on the last voyage of the steamship "Paris" to offer my services to the Government as an expert signal officer and telegrapher familiar with Spanish, and an immune.

Subsequently in riding through the interior of Cuba I discovered rubber of the *costiloa elastica* and other varieties to be indigenous, and so reported to the Agricultural Department. Capitalists not caring to invest in Cuba, I was induced to transfer my attention to Porto Rico. But finding only a limited area of swamp land there adapted to rubber I directed my attention to the Philippines as being located in the rubber belt and possessing the environments and low lands adapted to rubber growing.

My reports and correspondence to the Agricultural and War departments, through Secretary Penrose, of my State, and dating back to the first occupation of the Philippines, were duly referred to the Department officials. Through persistent attention and agitation in Congressional committees asking increased appropriation, the matter was kept before the officials. The War Department, referring all matter to the Philippine Commission, who in turn handed the subject over to the Forestry Bureau, then under control of an army officer detailed to look after the timber interests. The Congressional investigation into the proposed timber land franchises and the Major Hawkin Heinstand hemp inquiries, made officials a bit shy of "rubber investigation." The matter was, however, urged upon the Philippine Commission, and resulted in ordering a foreign scientist to make an examination into the subject of gutta percha. It was at once developed that for some time a large business had been carried on in Mindanao by Chinese merchants, who had shipped or smuggled to Singapore hundreds of thousands of dollars' worth of crude gutta, which had been obtained by a ruthless destruction of 25,000 trees in

a short time. This gutta paid nothing to the island, not even the forestry taxes, but was credited as an English export from Singapore. The business was so profitable to the Chinese that they were able to pay a steamer $100 in gold per day to carry the gutta out of the country. This loss was sustained because steps were not sooner taken to protect the industry. The damage by destruction of the trees is almost irreparable.

The Philippine Commission's report in the advance or proof sheets referring to the existence of gutta in the islands says in effect:

"It appears that while many trees produce gutta mixed with resinous or other substances, the main source of gutta, which is available for commercial purposes, is afforded by trees belonging to two genera *dichopsis* and *paycena*, the former species producing the best gutta known. The destructive method of exhausting by the natives, who cut the trees down and ring them, is unnecessary. It is possible to obtain more satisfactory results by careful tapping without injuring the tree. In 1843 gutta percha trees were abundant on Singapore Island, and on the Malay Peninsula, but they have been so thoroughly cleaned out that the botanical gardens at Singapore cannot obtain plants. The destruction of gutta trees in Sumatra and Borneo have been widespread. The demand for gutta steadily increases like that of rubber, while the supply as steadily decreases. The gutta trade is principally in the hands of the Chinese of Sinpagore, who adulterate in every conceivable way. There is a demand 600 times greater than the supply."

The danger of a famine in gutta, which would prevent cable operations, is as great as that of rubber, and perhaps the discovery of gutta will facilitate the Pacific cable. The officers of the United States Signal Corps, many of whom are expert cable operators and practical electricians, are now giving this subject of gutta, in connection with the manufacture of a Pacific cable, their energetic attention, and beneficial results may be expected in the estimates of the cost due to our own possessions furnishing insulation.

The Signal officers will give the matter of the product of trees, like those of gutta and rubber, especial consideration with a view to advancing the telegraph and cable enterprise of the Government. The trouble heretofore has been that the Forestry Bureau of the Philippines, which is a product of the Spanish occupation, and basing their report on the work of the native forester, only look to the value of a forest by the number of trees that are useful as timber for its various purposes of supplying hard woods for furniture, or trunks of trees adapted for piling or woods for railroad ties, building operations, etc.

A gutta percha or rubber tree standing is worth an average of $20 per tree each season for 40 years, and several hundred trees may be cultivated to the acre at relatively less cost wtih greater returns than from any growing product of the earth.

It is estimated by the Commission that 300,000,000 lbs. of gutta percha have been exported from Singapore during the last 50 years, involving the destruction of at least 150,000,000 trees, and the waste by imperfect collection of some 3,000,000 lbs.

The Philippines were credited with 232½ piculs of gutta percha of 133 lbs. each, and only 5 piculs of inferior gutta during the last six months of the year 1900. This does not represent the total amount exported, as most goes to Singapore and is credited to British North Borneo. Active steps are now being taken by the tropical authorities of the different governments for the propagation of the gutta trees by seed, which is more satisfactory than plants.

Great Britain and Holland are the countries owning all known gutta percha lands outside of the Philippines. They are taking active steps not only to preserve the trees but to establish new plantations. Germany has long had an agent in gutta and rubber producing countries with a view to the introduction of the trees into her African and New Guinea possessions. Some years ago France sent gutta seedlings to all her tropical possessions, a representative of that government visited Borneo. Another representative is now investigating in Java. Yet our Government is slow to take up a matter of such importance and hesitates at appointing a practical expert to assist in developing a great industry.

Holland at present monopolizes all gutta seed, which has become so valuable because of the ruthless destruction of trees that it is found more profitable to keep trees for the seed than to extract gutta from them.

Although the best gutta-producing tree, *dichopsis gutta*, is not yet found in the present open territory, there is no doubt that if it does not already exist the best species can be grown in our own possessions, which is in the same latitude with the habitat in North Borneo. The identification of the genuine rubber and gutta tree must be determined by practical experts. Unquestionably the rubber trees from the Amazon may be transplanted and be grown in the new possessions, several varieties already being found to be indigenous.

A new departure is being made by establishing a Philippines Agricultural Department, which will no doubt relieve the army officers of their detached duty as scientific agriculturists and forests. Professor P. Samson Scribner, a well-known practical and thoroughly scientific gentleman has been placed at the head of the Philippine Agricultural Bureau, who will look after rubber and gutta for the Agricultural Department.

The Telegraph System of Brazil.

"The Telegraph System of Brazil" is the subject of an interesting report to the State Department by Thomas C. Dawson, secretary of the United States legation at Rio de Janeiro. Under date of Nov. 8, 1901, he writes:

The telegraph lines in Brazil are almost entirely owned and operated by the Federal Government. The States of Sao Paulo, Rio Grande do Sul and Ceara have a few comparatively unimportant and unprofitable lines. Certain railroads are permitted to take messages for transmission between points not served by the Federal lines, and are said not to confine themselves to those points. The cable between Para and Manaos is privately owned, though receiving a subsidy from the Government. The coastwise foreign-owned cables do much of the business between the ports from Pernambuco to Santos, as well as practically all the service to points abroad.

The first telegraph line in Brazil was established in 1861, serving Rio and Petropolis. The serious development of a system to serve the whole country began in 1865. The plan adopted is a main line running along the entire sea coast with branches out into the populated regions. In at least three instances, these branches are connected, thus furnishing separate overland communication between Pernambuco and Bahia, Bahia and Rio, and Pernangua and Porto Alegre; in addition to the cost line. * * * When the republic succeeded the empire in 1889, the coast cities and the principal points in the interior on lines of railway had telegraphic service. Under the republic the policy was to extend the branches to reach all populated centers, and the total length of the line was nearly doubled in the following six years.

The main coast line extends from Para to Jaguarao, on the Uruguayan border, is 6849 kilometers (4256 miles) long, and has 23,837 kilometers (14,812 miles) of wire. In the year 1899, 1,348,956 messages, containing 21,284,437 words, were transmitted, for which the average charge was 4613 reis per message and 391 reis per word. Expressed in terms of United States currency at the average rate of 1899, these were equal to 69.2 and 4.4 cents, respectively, and, at the present rate, to $1.09 and 6.9 cents. The milreis tolls have not been decreased to correspond with the rise in exchange. Six hundred reis (8.2 cents) are charged as a fixed tax on each message, no matter what its length, and in addition thereto for each word, including address and signature, from 120 reis to 1070 reis. The minimum rate is confined to messages to stations in the State where the message originates. To the next adjoining State, at least twice as much is charged, and the rate increases by States with their remoteness. The rates on the foreign-owned cable lines, which are much used between the coast cities on account of the superiority and certainty of delivery and intelligibility, are about twice as high.

The officially reported cost of operating the department in 1899 was 7,505,952 milreis, equivalent at the then exchange to $1,126,000, and at the present to $1,771,000. In addition the subsidy to the Para Amazon Cable Company of £17,125 was paid, and 432,000 milreis to other companies to indemnify them for tolls collected by the Brazilian Government for joint traffic. Two thousand nine hundred and twenty-seven persons were employed; 140 in the central administration, 1391 on the line and 1396 in the stations. They were paid 5,891,502 milreis. The revenue from private telegrams within the country was 4,717,445 milreis; from official telegrams sent by and charged against other departments, 1,036,762 milreis; from Brazil's proportion of telegrams from and to foreign countries, 360,894 milreis. The department has never paid for itself.

The Debt of Electrical Engineering to C. E. L. Brown—VIII.

BY B. A. BEHREND.

OLTEN-AARBURG CENTRAL STATION.

THE station at Aarburg represents surely one of the most interesting plants of Mr. Brown's many-sided work. There were installed in 1895 six 300-hp, two-phase generators, direct connected to turbines running at 28.5 r. p. m. The generators are of the umbrella type, having a diameter of 4500 mm. They operate at 5000 volts and 40 cycles, and hence have 168 poles. Such slow-speed machines have never been built by anybody but Brown. They were originally made as inductor generators, but they failed to give the pressure for which they were designed, and this fact was much talked about among electrical engineers. But it is rarely either wise or instructive to treat even the errors of a really great man with mere ridicule, and in the present case, after seeing the ineffectiveness of his construction, their designer went ahead and altered within an astonishingly short time the inductor generator into a revolving field machine.

Gross exaggerations have been spread about the poor performance of the Aarburg generators, but a glance at the curves of Fig. 44 and the diagram in Fig. 45 shows that these machines really do their duty very well. The voltage rises 13 per cent if a load of 19.6 amperes is thrown off, while they are very well capable of giving 245 kilovolt amperes on a circuit of a power factor of 80 per cent. Their efficiency at load of 200 kw is 88 per cent, which is a good result for so small an output at so slow a speed. The plant is shown in Fig. 46.

RATHAUSEN.

A model slow-speed station is Rathausen, where five 300-hp generators are operating at a speed of 60 revolutions, giving two-phase current of 3300 volts at 40 cycles. Fig. 43 shows the station, Fig. 47 one of the generators, and Fig. 52 its performance curve. In the following we give the data of this machine as published by Mr. Brown sometime ago:

Armature.—Per phase 40 coils of 27 turns. Resistance per phase, 2.25 ohms hot.

Field.—Eighty coils of 43 turns. Resistance, .45 ohm.

The efficiency of this machine for 200 kw is 93 per cent in spite of the small output and low speed.

PADERNO.

The Paderno installation constructed in 1897 and 1898, with its seven 14,500-volt, 1850-kw direct-connected generators transmitting electric power to Milan over a distance of 22 English miles, stands out foremost among the large power transmission plants of the past five years. Fig. 48 shows the plant in course of construction, Fig. 51 shows a drawing of the generator, Fig. 49 shows a view, and finally Fig. 50 represents the performance curve of this machine.

The output of these generators is 73.5 amperes at 14,500 volts and 42 cycles. They are three-phase machines and yield 1850 kilovolt amperes on a circuit of 80 per cent power factor. The speed of the turbines is 180 r. p. m. From Fig. 50 we see that the rise of voltage when full non-inductive load is thrown off, is only 4.2 per cent, while throwing off 1850 k. v. a. on a power factor of 80 per cent produces a rise of only 15 per cent.

Through Mr. Brown's great courtesy we are enabled to give here the winding data of this machine, and a full account of the insulation tests.

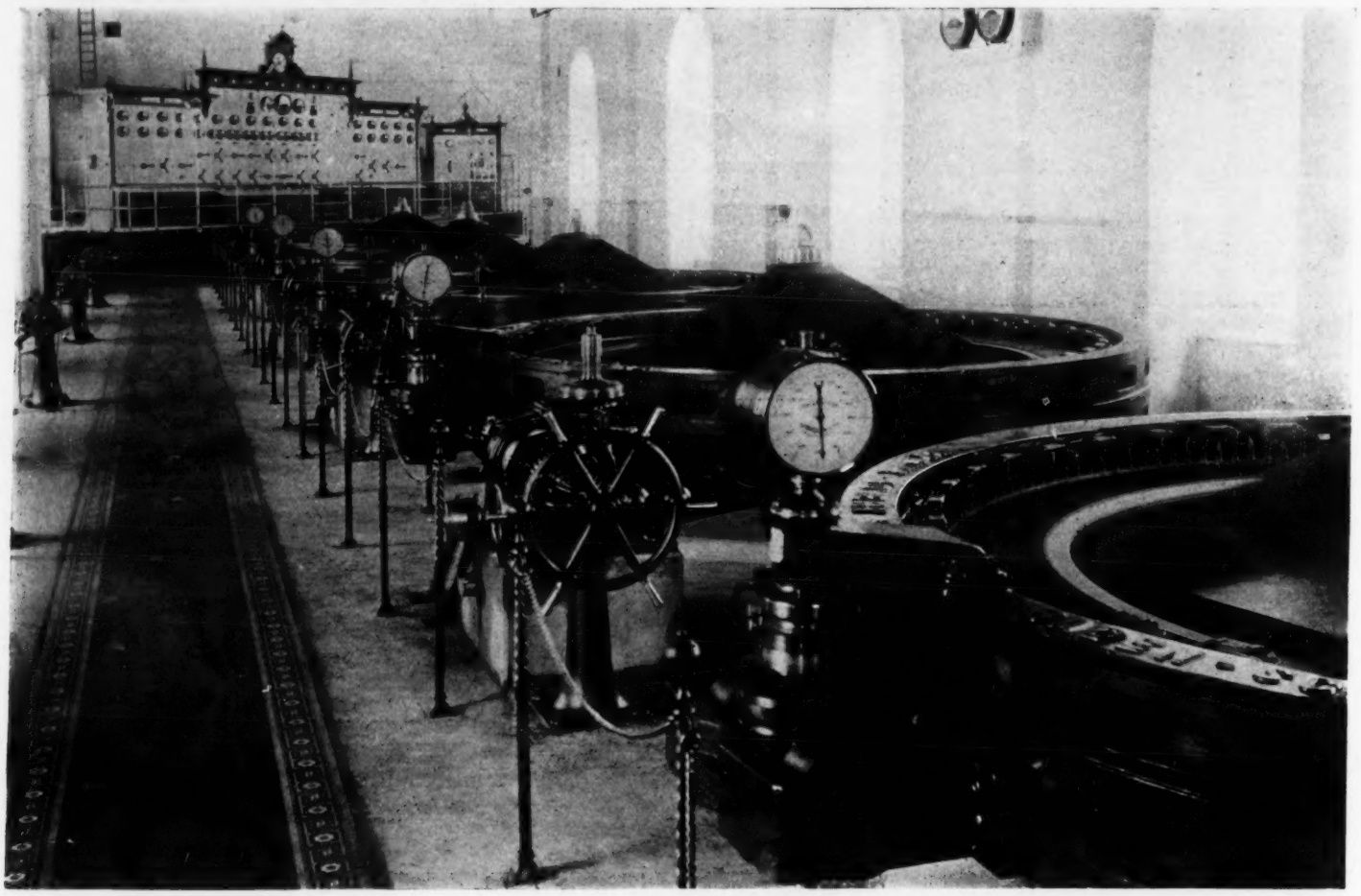


FIG. 43.—RATHAUSEN TWO-PHASE GENERATING PLANT.

Armature Winding.—Three-phase winding in Y-connection, 14 coils per phase. Per coil, 30 turns of 6-mm. wire. Resistance of each phase, .76 ohm.

Field Winding.—Twenty-eight coils in series. Per coil, 71 turns of copper strip on edge, 3 by 32 mm. Resistance of field coils, .46 ohm.

Mr. Brown writes about the tests on this machine: "Before being put into the armature the micanite tubes were subjected to a six hours' test with a tension of 30,000 volts alternating applied between an iron tube placed inside the micanite tube and a cover of tinfoil on the outside of the tube—the length of the tinfoil covering being equal to the iron breadth of the armature. Tubes which heated during this test were rejected.

"After the generator had been erected we ran it for about five minutes with a tension of 21,000 volts by increasing the speed and exciting fully. We further carried out the following test with a special

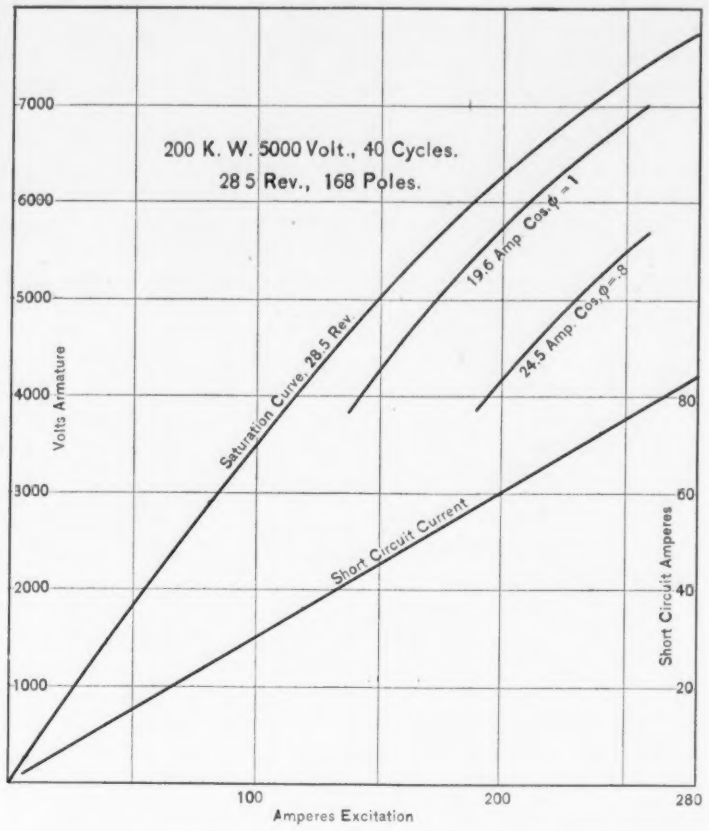


FIG. 44.—PERFORMANCE CURVES OF AARBURG GENERATORS.

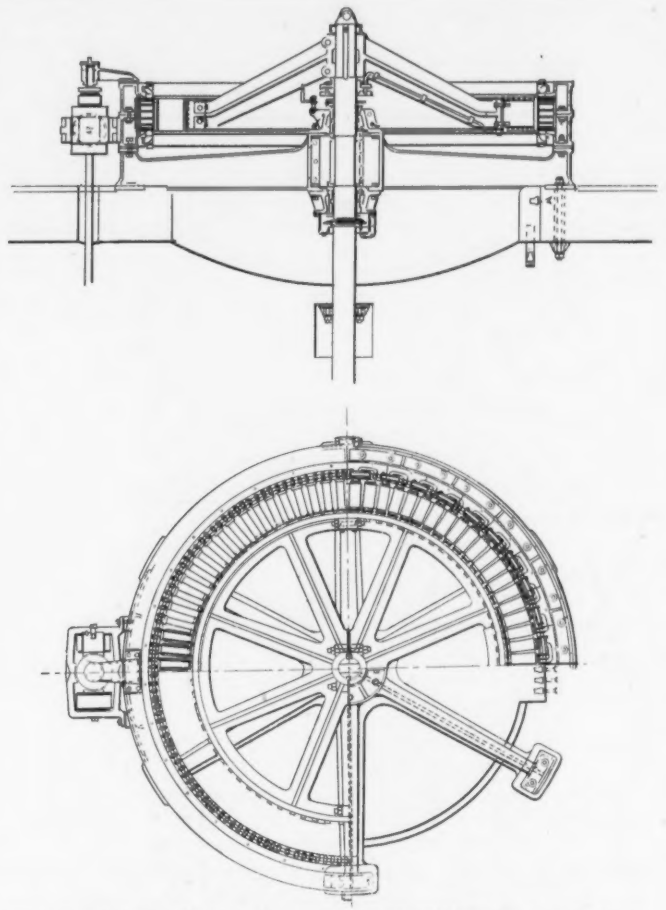


FIG. 47.—300-HP, 60 R. P. M., TWO-PHASE GENERATOR, RATHAUSEN.

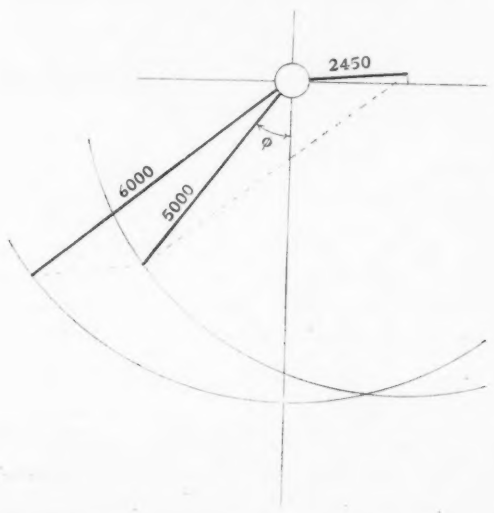


FIG. 45.—DIAGRAM OF POTENTIAL DROP IN AARBURG GENERATORS.

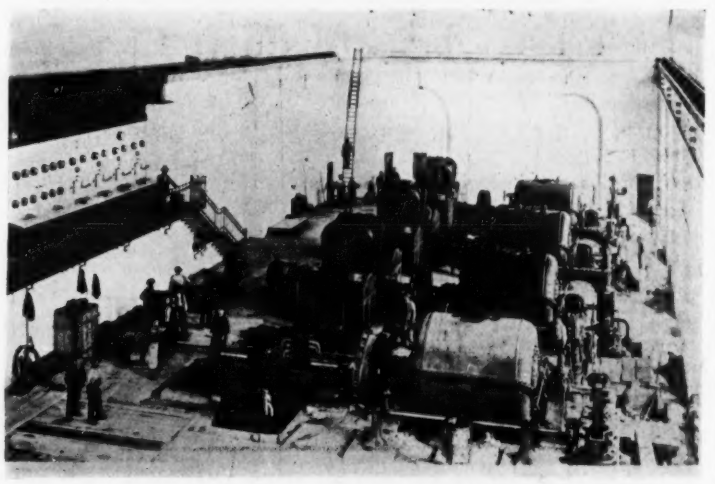


FIG. 48.—PADERNO GENERATING PLANT.

FIG. 46.—AARBURG TWO-PHASE GENERATING PLANT.

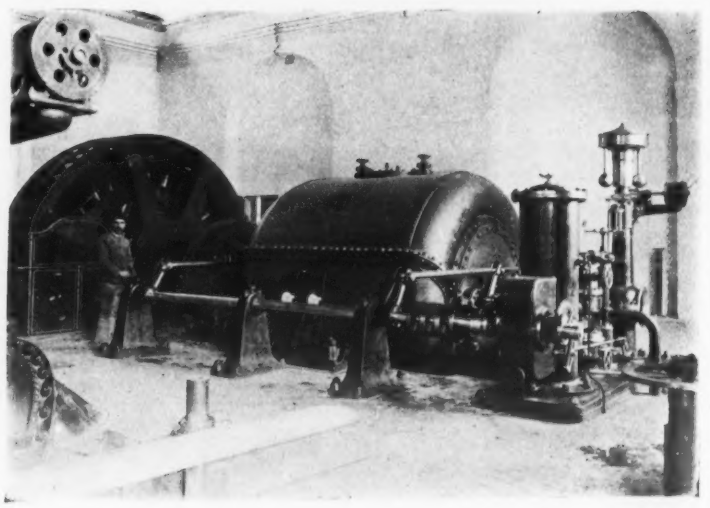


FIG. 49.—VIEW OF PADERNO GENERATOR.

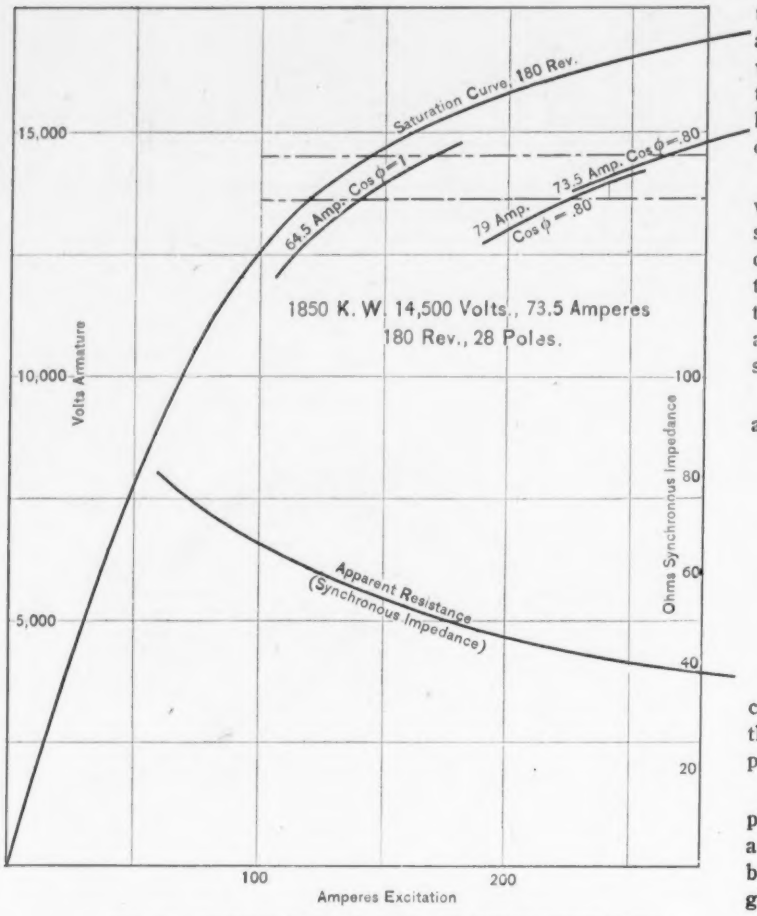


FIG. 50.—PERFORMANCE CURVES OF PADERNO GENERATORS.

transformer: We opened the three-phase winding of a generator at the neutral point of the star connection and, whilst the machine was standing still, applied a tension of 30,000 volts on each pair of the three phases separately. We also applied a tension of 20,000 volts between frame and winding for one hour. All these tests were carried out without the slightest difficulty being experienced.

"In order to give you an idea of the excellence of the insulation, I will relate to you an accident which happened, and which really constitutes the best possible proof. One of the generators with its direct-coupled exciter was running fully loaded when the fuses blew and as the turbine governor failed to act the speed rose to 1.7 to 1.8 times the normal. The excitation was not cut out until after 1½ minutes, and, although the pressure went up to over 30,000 volts, not the slightest accident happened."

The losses of this generator if working on a non-inductive load are as follows:

	Watts.
Core loss	41,000
C^2R armature	9,000
Excitation	11,800
Total losses, excepting windage and friction	62,300
Windage and friction	20,500

The efficiency of direct-connected machines is generally figured according to the Rules of the American Institute, without the loss through windage and friction, and we thus get an efficiency of 96.15 per cent at full non-inductive load.

The Paderno water-power plant operates in parallel with the steam plant at Porta Volta in Milan. This plant, of which Fig. 38 is from a photograph, was in operation before the Paderno installation was built. Both plants have operated for years in parallel without having given the slightest disturbance. The turbine governors in Paderno are equipped with electric motors that can be controlled from the

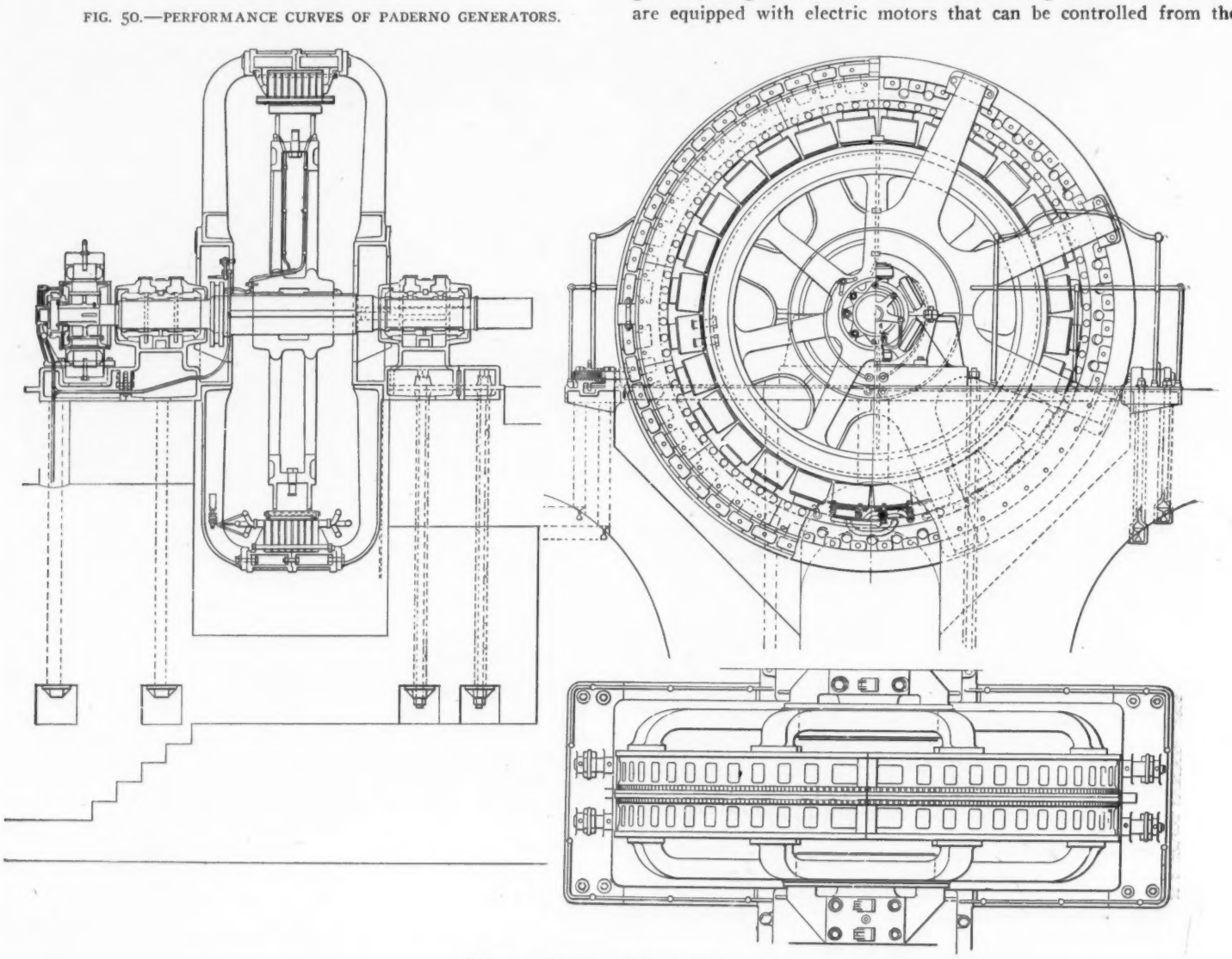


FIG. 51.—PADERNO GENERATOR.

switchboard to distribute the load between the generators and to parallel them with greater facility. Mr. Brown seems never to have had trouble with "hunting" of alternators working in parallel. Steam engines of good design and the use of solid poles doubtless account for his having been spared these troubles. Furthermore, his flywheel

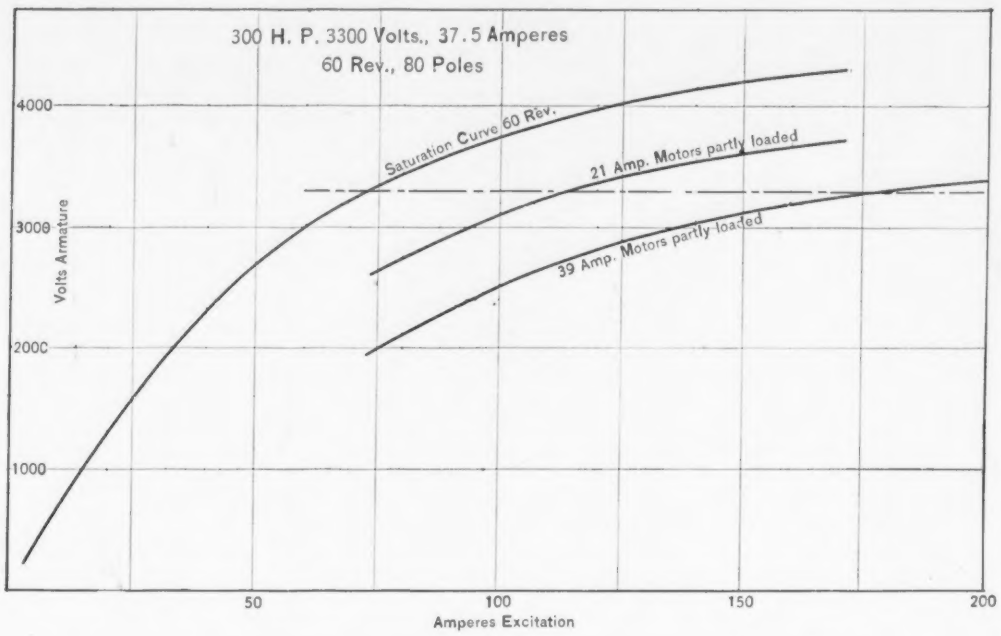


FIG. 52.—PERFORMANCE CURVES OF TWO-PHASE RATHAUSEN GENERATORS.

type is particularly well adapted to parallel running. In the case of the Paderno-Milano plant, the poles of the Porta Volta generators alone are solid, while the Paderno generators have laminated pole tips.

Notable Development of the Canadian Niagara Power Plant.

No electrical engineering work has equaled in interest and importance the development of the great enterprise for the utilization of Niagara by the Niagara Falls Power Company. There is nothing in the world equal to this splendid example of electric power generation and transmission, and our readers are already familiar with the details of the plant as described in the numerous articles that have appeared in our columns on the subject. The news which we are now able to give, however, will show that so far from finality having been reached in the plans of the company, this work is but in the earlier stages. The latest features of development are such as to arrest more than ever the attention of engineers and capitalists. On the American side, where all the work has been done hitherto, newer machinery of the very latest type of its class has just been ordered, while for the hitherto unattempted utilization of the water power on the Canadian side of the great cataract, the Niagara Falls Power Company has just given a contract to the General Electric Company for three immense units of 10,000 hp each. These machines are not only to be the largest electric generators ever built, but they will embody features of design of the utmost significance, altogether aside from the fact that the new work is to be done under American initiative with American capital and employing American apparatus.

We understand from the Canadian Niagara Power Company, which has just awarded the contract, that these gigantic generators are but the first units in a plant which will probably reach an aggregate of 200,000 hp or more, within a very few years. The power house is to be situated on the flatland adjacent to the Dufferin Islands near the river, less than a quarter of a mile above the Horseshoe Falls. A wheel pit is being excavated in the rock which will be connected by a tunnel tailrace to the gorge below the falls. The dynamos will be placed at the surface level as before, being connected to the turbines by long, vertical shafts, which extend to the bottom of the pit where the turbines will be situated.

The machines contracted for are, as already noted, far larger in capacity than any electric generators previously built. They are also remarkable on account of the high speed at which they will operate, 250 r. p. m, the same as that now used with the smaller 5000-hp generators on the American side. A design has been provided, which affords the best electrical conditions and a very compact form. The external diameter of these machines will be not quite 18 ft., and the total weight of each about 400,000 lbs. They will return 98 per cent of the shaft horse-power in the form of current, and the inherent regulation will be such that the voltage variations will not exceed 8 per cent with maximum possible changes of load. Two very important elements are that the machines will have internal revolving fields, while the older smaller machines have external fields; and that they will not depend on transformers for raising the pressure of the current from 2200 to about five times that figure for the line, but will generate themselves current at the tremendous potential of 12,000 volts, thus dispensing entirely with expensive transforming apparatus.

The adoption of these enormous units in place of the large 5000-hp generators previously the standard at Niagara Falls, is the result of recommendations made by the General Electric Company's engineers and effects an immense saving in the cost of this power development. It reduces the wheel pit excavation and the size of the power house to about one-half, causes a very large reduction in the cost of electrical apparatus per horse-power, and sacrifices absolutely nothing in reliability or efficiency.

This, it may perhaps be worth noting, is the third large contract for generators at Niagara Falls, which has been awarded to the General Electric Company during the past 12 months, including six of the earlier type of 5000-hp machines for the second American power house; five of 5000 hp of a new type for the same plant, and now these huge generators for the Canadian side. No announcement is made yet as to the turbine contract, but it is understood it will go to Switzerland.

Alleged Vast Trolley Network.

It is reported that to exceed the speed made by the fastest trains between New York and St. Louis is the aim of the promoters of an electric system which is to connect the cities by Jan. 1, 1903. This enterprise is backed by New York, Ohio and Michigan capitalists, and it is alleged that much of the money will be supplied by Senator Depew. We doubt it very much. L. P. Myers is securing a 100-foot right of way through all territory intended to be traversed by the new line. Myers says the road will be built of 70-lb. steel rails, double track in many sections, and stone ballast. Orders for rails, sleepers and other equipment of the most modern type are said to have been placed with the manufacturers, but cannot be traced by us. He says the plan is to buy up all the interurban lines in operation in the territory and merge them into one great system.

Profiles now in hand indicate that the line will run from New York to Rochester and Buffalo; that connections will be afforded with Cincinnati, Cleveland, Toledo, Columbus, Fostoria, Tiffin and Springfield, in Ohio; that service is to be given Detroit, Jackson, Battle Creek, Lansing, Ionia, Grand Rapids, Muskegon, and other points in Michigan. The route then passes through cities of Northern Indiana and westward into Chicago. Springfield and numerous smaller places are on the line, St. Louis being the Western terminus.

The cars are to be of the powerful twin motor type, fitted in a luxurious style. All plans for the construction of the road have been completed. Options are being secured in the name of E. Blackman, of New York, who is one of the originators of the scheme.

Automobile Club of America.

The Automobile Club of America has just issued its new year book for 1902, bound in white and dark gray, giving the names of 291 active and 62 associate members, or 353 in all, who own no fewer than 380 automobiles and have 91 new ones under order. The club is growing rapidly, and under President Shattuck is doing excellent work. The book contains considerable information.

Electricity for the New York Central Tunnel.

BY FRANK J. SPRAGUE.

I NOTE that ELECTRICAL WORLD AND ENGINEER has published in its issue of Jan. 25 the recent letter of Mr. Westinghouse on electric traction and safe care for the New York Central Railroad, my reply thereto, and his second letter, this correspondence having appeared in the *New York Times*. I feel, however, that the second letter from Mr. Westinghouse and the facts in the case require further consideration at my hands, and I take advantage of the hospitality of these columns to defend once more what I deem the best interests of the electric traction art, including those with which I happen to be also more or less identified as their exponent. Mr. Westinghouse, moreover, has no monopoly of public concern. The necessity of doing everything possible to avoid the dangers of fire in a car propelled electrically or otherwise, is apparent to all, and would naturally command support even if recommended by less eminent authority. So, too, will all practical proposals for increasing the structural strength of cars, reducing the liability of crushing and telescoping in a collision, and improving brakes and signals. But the electrical and the transportation world must not be thrown into a panic, and stampeded into paralysis because some particular method of car construction is not found in all existing rolling stock, and because all the possible improvements permitted in new work cannot be universally applied. The simple fact is that Mr. Westinghouse, for reasons of his own, has in the matter of the New York Central tunnel practically asserted that the present problem cannot be solved electrically because the method which he assumes will be recommended is that of motors distributed under the cars, and, the existing cars being combustible, this is dangerous, and hence such a plan must not be considered. All alternative or composite schemes are entirely ignored.

Whatever the detail plans which the New York Central may have under advisement, and as to this my guess is probably as near correct as that of any other outsider, which guess is that Mr. Westinghouse is very much in error, I have not the slightest hesitation in saying that every train movement in the tunnel and at the Grand Central terminus can be efficiently, promptly and safely made under electrical operation. And if it be true, which I do not think it is, that no electrical manufacturer would undertake such a contract, then it is proper to say that there are contracting and constructing engineers who would not hesitate to assume the task, and Mr. Wesinghouse's disinterestedness is not sufficient to make him refuse to supply any needed apparatus of his manufacture which might be found suitable. He should not speak of inventors and manufacturers in terms of suggested disparagement because his particular pride has long been to be a shining light among those classes.

The real problems before the Central management are not alone operative ones, intensified by limited track room, lack of storage space, and consequent congestion of movement, but also those of civil engineering. The proposal to loop the suburban tracks, no matter how the trains are operated, is commendable in the highest degree. But it is certain that such a loop will be operated electrically, and the natural corollary is that the electrical operation will ultimately be carried beyond the limits of the tunnel, at least as to the normal operation of these trains, in which case multiple unit operation, possibly with cars of new construction, will most likely be adopted.

Another problem is the handling of existing trains undisturbed in make-up or equipment, hauled to some point within reasonable radius of the Grand Central station by steam. It is clear that for this terminal work the motors will not be distributed under passenger cars.

It is reported that Mr. Yerkes intends to introduce on the Metropolitan District Railway, of London, an improved type of car. I doubt not that this is so, and that it will be made just as strong and as free from the possibilities of damage by collision and by fire as it is practical to make it, that steel construction for at least the under body of the car will be adopted, but more for structural purposes than because of electrical dangers. In this connection it is proper to point out that most modern cars on the Continent of Europe are so built to-day, and the cars on the Versailles division of the Western Railway of France, operated on the multiple unit plan, are constructed in this fashion. It is also likely that some parts of the upper structure may be made of steel, and other parts of wood or other material treated so as to be non-inflammable, the same as is now required on modern battleships.

The ordinary possibilities of fire on an electric car may briefly be summarized under three heads: Flashing at the contact shoes, which, being carried on an all-steel truck, may be now discounted; breaking of connections or chafing of wires extending from the motors on the truck to the controlling apparatus on a car, caused by frequent and extreme movements of pivoted trucks, which can be avoided largely by good construction, and so far as the car is concerned by proper sheathing, and the making and breaking of current in the main motor controllers. Special insulation is essential in the running of circuits, and it must be provided either naturally in the car construction or by special precautions, whether the car be of wood or steel, more in the latter case. It goes almost without saying that the controlling apparatus itself may, and should be so constructed that no matter what the internal trouble, or what the amount of arcing due to bad or misplaced contacts, the disturbance shall be entirely local, and shall be kept so by being enclosed in an iron-clad structure.

Common sense and prudence then indicate that whatever improvements in car construction may be introduced in the progress of the art, the first essential is to make the apparatus itself which controls motors reliable and fireproof, and then to protect its installation, and the installation of the motor equipment by the best methods known to the art to-day. It is safe to say that when this precaution is taken, the operation of the electrical train is amply safe, Mr. Westinghouse to the contrary notwithstanding. The presence of wood of itself is oftentimes a matter of safety rather than danger in electrical construction, because when properly protected it is not only a good insulator, and, therefore, avoids one of the initial possibilities of electrical trouble, but, properly sheathed with fireproof material the risk from its use is reduced to a minimum. On account of the use of the grounded circuit, the presence of steel renders less possible the absolute isolation of different parts of the electrical equipment and can introduce possibilities of trouble which are foreign to some other construction.

Mr. Westinghouse must find himself in a somewhat embarrassing position, to illustrate which I may refer to a bit of recent history. He states unequivocably that any use of motors under care of present construction on elevated trains or in a tunnel is reprehensible and dangerous. If this be his present contention, in what light does he stand before the management of the Brooklyn Elevated Railway, where, in 1898, he began applying motors under the existing cars. On this road, which, so far as electrically equipped, is operated strictly on the multiple unit plan, there have been three classes of apparatus used, some being of Westinghouse make. Notwithstanding the specific experience of over two years, despite all the changes which had been made and troubles which had been experienced, concerning which he could not be in ignorance, and notwithstanding the fact that the controllers had been taken from under the cars where they were inoperative, and installed inside the cars, the Westinghouse Company, undoubtedly under guarantees of safe and efficient operation, have within the past year made a contract for a number of equipments to be used under the regular cars, in competition with others, at prices and under conditions of payment and guarantees which no competitor would for one moment entertain and which carry their own story, to do the very thing which Mr. Westinghouse himself now condemns. And this contract was supplemented by a proposal to equip the Manhattan Elevated Railway on the multiple unit plan, using the existing cars. Should that collision and accompanying holocaust which he now freely predicts occur on the Brooklyn Elevated with cars equipped with his apparatus, in what contradictory and dangerous position will he and the Brooklyn Elevated Railway find themselves in view of his former protestations and his recent utterances.

Really, if all that is predicted is in any measure true, if it is impossible for all practical purposes to protect existing cars so that they may be safely operated electrically, then the 50,000 railway cars in this country would better be pitched into the scrap heap, the Manhattan, Brooklyn, Boston and Chicago Elevated railways would better replace their wooden ties and do away with guard rails, or go back to steam, electrical science turn backward, and horses and the cable be restored to their former pre-eminence.

American Manufactures.

According to statistics collected by the Census Bureau the gross value of the products of manufacture in the United States in 1900 was $13,003,127,682, as compared with $9,372,437,282 in 1890, an increase of 38.73 per cent.

The Shawinigan Electric Power Plant, Canada.

By FRANK C. PERKINS.

THERE is a great industrial and commercial future for Shawinigan Falls on account of its recent power development. The accompanying map (Fig. 3) shows its location and the general direction of power transmission lines intended to reach Quebec and Montreal, the former 90 miles distant, and the latter 84 miles away. Three Rivers, which is located 21 miles from Shawinigan Falls, will soon have electric service from this power house, as will many of the towns along the Great Northern Railway between Quebec and Montreal. For a number of years the great power of the St. Maurice River has attracted the attention of promoters; but until recently the title to the property and water has been more or less complicated. The Privy Council of England decided not long ago that the provincial government could dispose of its water powers, and the authorities have been selling these privileges with the understanding that the development be begun immediately.

The Shawinigan Water & Power Company was formed under a charter granted by the provincial government, with the power to develop the water power, manufacture gas and electricity for the purpose of light, heat and motive power, to construct works needed for such purposes, to transmit power generally throughout the Province of Quebec, and to transmit electric power and sell same in the various towns and cities, with the right to expropriate land for its various purposes, including the necessary right of way to any point. The president of the Shawinigan Water & Power Company is J. N. Greenshields, K. C., of Montreal; the vice-president is John Joyce, of Andover, Mass., and the treasurer is Mr. J. E. Alfred, of Boston, Mass.

For the accompanying illustrations and data in reference to this power plant the writer is indebted to the secretary, Mr. Richard W. Douglas, and the chief engineer, Mr. Wallace C. Johnson, who has had much to do with the Niagara power development during recent years. The Shawinigan Falls Power system obtains its water by a canal 1000 ft. long, 100 ft. wide and 20 ft. deep. The water is conducted through this canal to a forebay, formed by building a solid concrete wall or bulkhead from which the water is conducted through pipes to the power house 130 ft. below. This substantial concrete wall is 40 ft. in height and 30 ft. in thickness at the bottom. Each pipe, waterwheel and generator will yield 5000 hp. The water for the operation of the wheel is obtained from the forebay, and is conducted in steel tubes to the power house, each tube having a diameter of 9 ft.

Three of these penstocks are now in place, and three more are still to be installed, and are now under way. The canal has a capacity of 60,000 hp, and the present development is for 30,000 hp. The company purchased about 1000 acres of land, of which 200 acres were reserved for mill sites and about 500 acres for the location of the town, the latter being particularly well adapted for this purpose being high and comparatively level. It is an ideal location for manufacturing plants, using large quantities of power, both electrical energy and water power privileges being available. The St. Maurice has a total length of over 400 miles, and is supplied from a great many lakes and streams, the drainage area being about 18,000 square miles. The water flow is very steady throughout the year on account of the dense forest covering this area, and is in the neighborhood of 26,000 cu. ft. per second. The power which may be developed will not fall short of 100,000 hp ultimately, and the working head is more than 125 ft. Besides the main development, it was decided to take advantage of the fact that at one point the Shawinigan River and the St. Maurice came within 1000 ft. of each other, but with the difference of level of 150 ft., and it was here on a point on the upper bay a second installation was made, this is about half a mile of the main power station of the Shawinigan Water & Power Company. This installation was built by the Belgo-Canadian Pulp Company, whose enormous pulp mill is supplied with water for operating their turbines by the Shawinigan Water & Power Company.

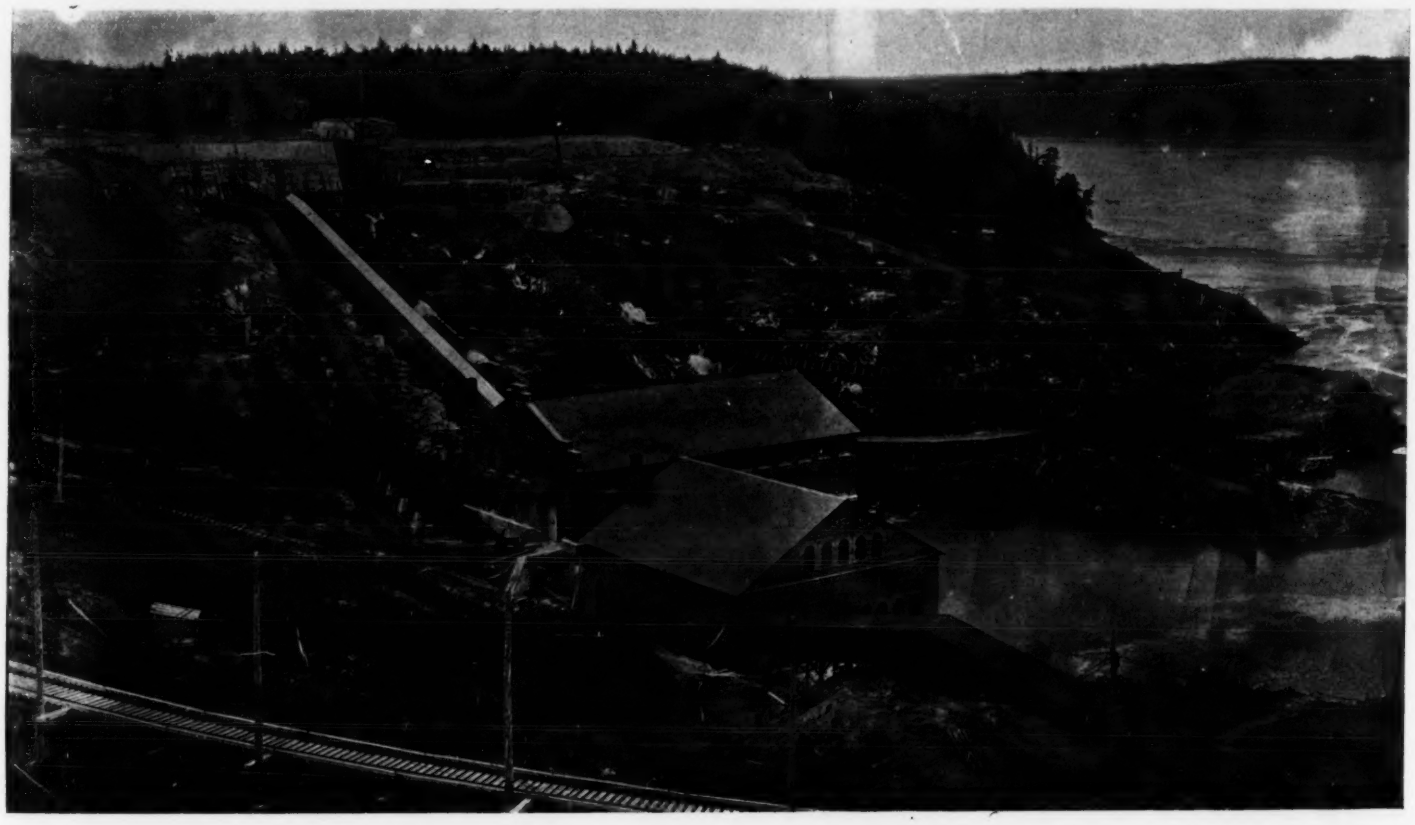


FIG. 1.—GENERAL VIEW OF DEVELOPMENT.

This development consists of a large crib dam through which the water passes at the bottom. The headworks consist of a concrete forebay, which has a height of 40 ft., with the necessary racks and head gates. This solid concrete bulkhead is inside of the crib dam on the bank of the river, and from it the penstocks lead the water through the bank and down to the lower level, discharging through the Shawinigan River as a tailrace after passing through the turbines. The steel penstock between the forebay and the mill is 12 ft. in diameter, and a special tunnel about 200 ft. long had to be excavated through the clay bank for its reception.

This plant will have a capacity of 15,000 hp, which is to be utilized by the Belgo-Canadian Pulp Company, but double this power may be obtained by duplicating the crib and bulkhead next to the present one. The present pulp mill will be able to turn out 10 tons of pulp per day, using for this work about 8000 hp, and an additional 7000 hp,

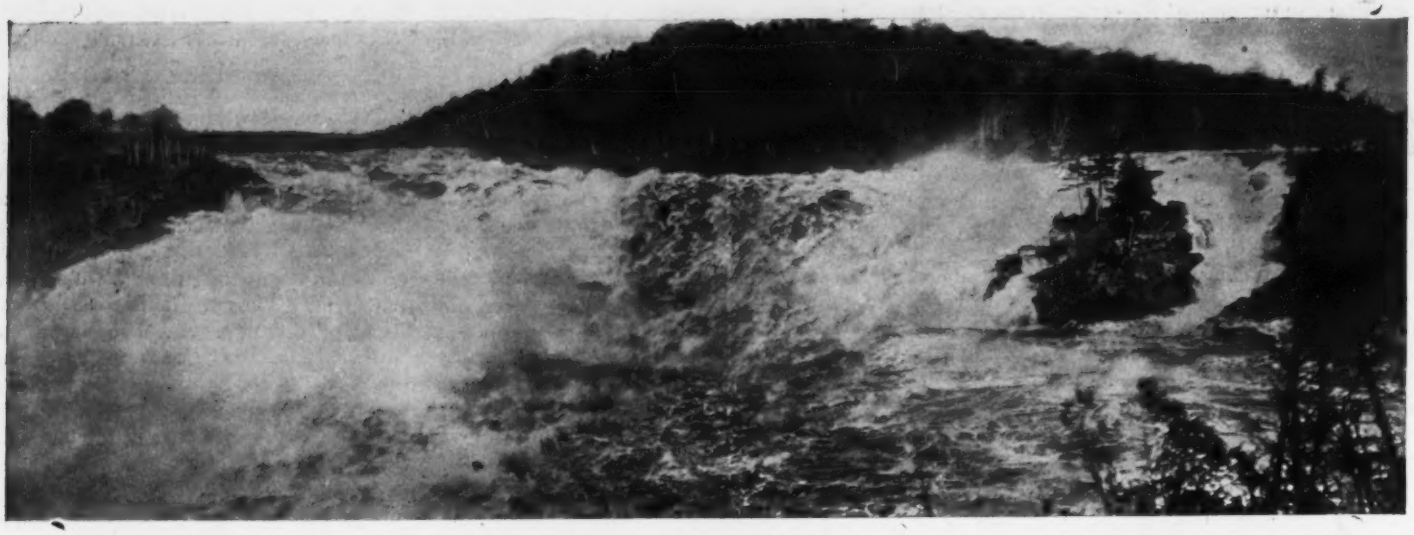


FIG. 2.—SHAWINIGAN FALLS.

making the entire 15,000 hp, will soon be used by another additional paper and sulphite mill.

The waterwheels in the main power house were built by the I. P. Morris Company, of Philadelphia, and each has a capacity of 6000

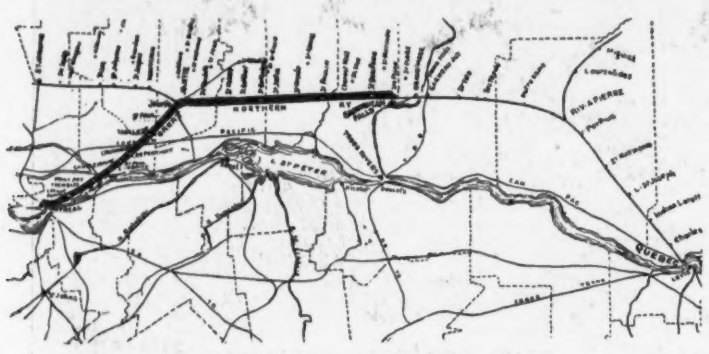


FIG. 3.—MAP OF TRANSMISSION LINES.

hp under a working head of 125 ft. Two of these turbines are now in course of erection (Fig. 6), and two alternating-current generators of 5000 hp are already installed. The generators were supplied by the Westinghouse Electric & Manufacturing Company. There is provision for another 6000-hp unit in the present power house, and an addition is provided for duplicating the present plant, which will increase the output to about 36,000 hp. The steel tubing from the forebay to the power house increases in diameter from 9 ft. to 11 ft. near the turbines, the thickness of the shell of the flume also increasing from 5-16 inch to 9-16 inch the diagram of the wheels shows them to be of the twin turbine type, having one runner at either end of the casing. The water enters the turbines radially from without, discharging radially toward the center of the shaft into the draft chambers. The draft chambers connect with an 8-ft. draft tube, which passes to the tail water. It increases in diameter to 11 ft. The tail has a low mean level of 25 ft. below the center of the wheel shaft. There are two large air chambers above the casing, which is of cylindrical form. The turbine is 30 ft. long, and is controlled by gates in the draft chambers. The gates consist of butterfly valves closing together at the center between the shafts. In connection with the transmission line between Shawinigan Falls and Montreal it is said negotiations are under way with the Great Northern Railway and other railroads whereby the power transmission line will run over their right of way for the greater part of the distance. This would not only lessen the first cost of the transmission, but would reduce the maintainance expense to a minimum, while the line in passing the 15 towns and cities would find many users of the electric current for incandescent lighting and motor service. It may be noted that the calcium carbide works have been established, and the large Pittsburg Reduction Company's plant is also in operation. The above mentioned concerns alone will use in the near future about 35,000 hp. The example of the Pittsburg Reduction Company and that of the Shawinigan Carbide Company is being followed by other users of electrical energy. An electric railway has recently been installed to take care of the increasing freight traffic. This line has a double overhead trolley line, two trolley poles being used to conduct the current to the motors.

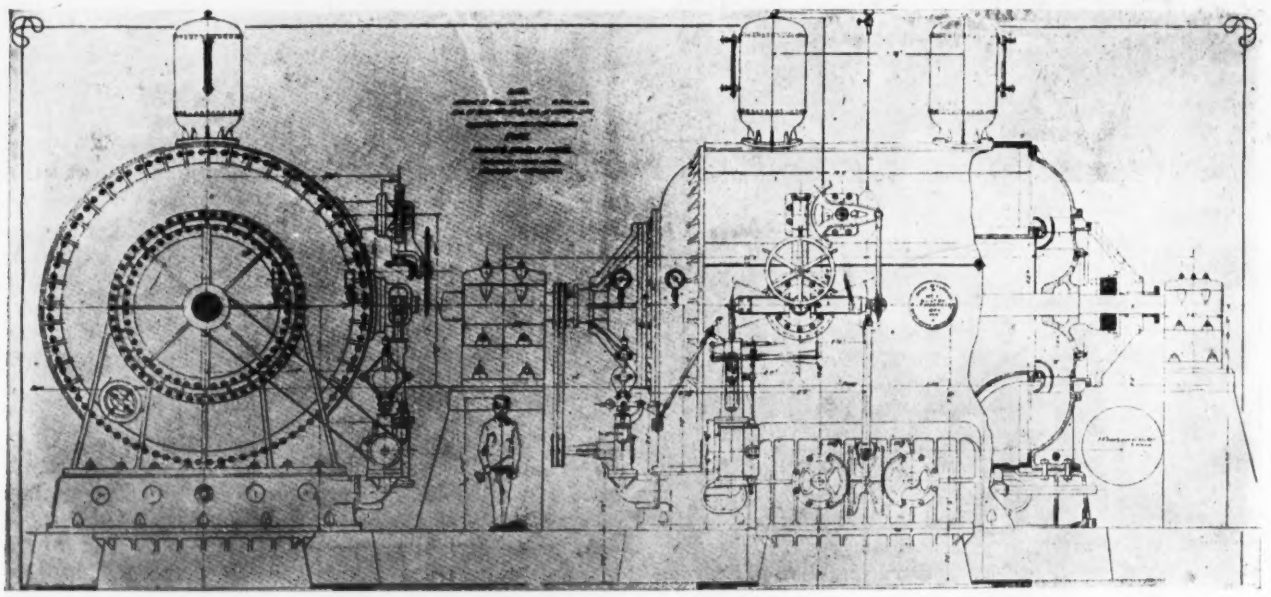


FIG. 4.—6000-HP TURBINES.

The Bremer Arc Lamp.

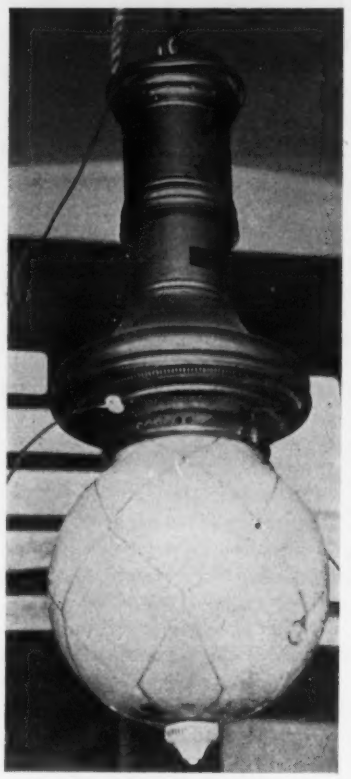


FIG. 1.—BREMER ARC LAMP.

FOR the past few years a new and interesting type of arc lamp, the invention of Hugo Bremer, of Neiheim, Germany, has received frequent notice in the columns of our foreign contemporaries, and recently practical trials in Germany of the lamp have been reported, at which very favorable results were obtained. Within the last month a number of lamps have been exhibited in operation in New York, and it is understood that the manufacture in this country will soon be undertaken. Two of the lamps are now in regular service outside the Plaza Hotel, West Fifty-ninth Street and Central Park.

The principal features of this lamp are the employment of a compounded carbon, the arrangement of the carbons at an acute angle to each other, the use of a metal chamber above the arc for reflecting the light downward, and the employment of a magnetic field for the automatic regulation of the arc.

The carbons are fed by gravity. When the arc lengthens to or near the breaking point as the carbons consume, an electromagnetically operated lever—the same which strikes the arc when the lamp starts into operation—re-establishes the arc, and by its motion causes the carbons to feed until the arc reaches the normal length.

Both of the carbons in this lamp are of quite small diameter, that of the positive carbon being about 7 mm. and of the negative carbon 6 mm., or about 5-16 inch and ¼ inch, respectively. The negative electrode is an ordinary solid carbon, but the positive electrode

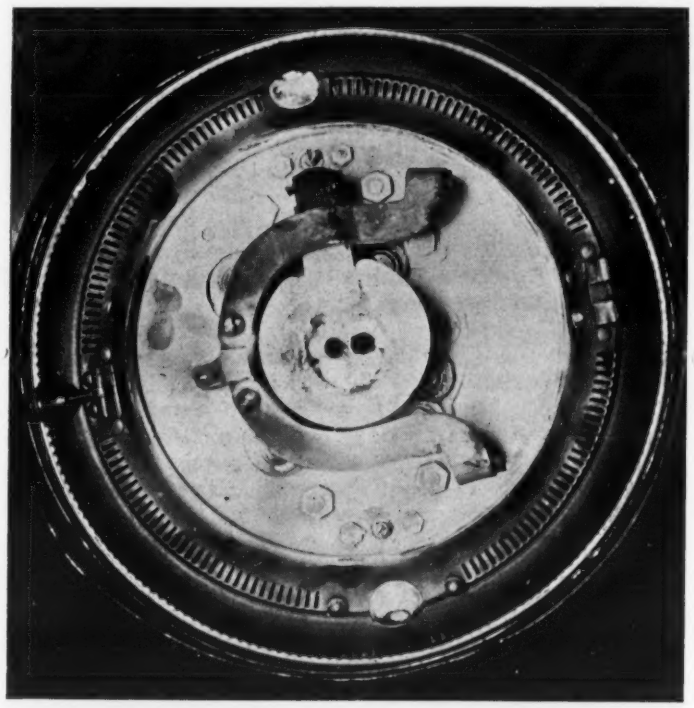


FIG. 2.—CARBON HOLDER AND REFLECTOR, SEEN END ON.

is a cored carbon of special composition. This carbon contains certain metallic salts in considerable quantity, of which magnesia is one, and also a certain proportion of boron or other material of the same family. In the past difficulty arose in the use of metallic salts in carbons, owing to the fact that they produce scoria, which tend to form an incombustible coating about the points of the electrodes, thereby interfering with or interrupting the arc. A special feature of the Bremer invention consists in the introduction of boron or similar material, as a flux, whereby the otherwise solid scoria is softened or liquified, thus enabling it to drip off and not interfere with the operation of the arc.

The two electrodes are inclined to each other at an acute angle, and the points are surrounded by a metal chamber open below. The magnesium in the positive carbon makes a snowy deposit on the surface of this reflector, thus providing a dull white, highly-reflecting surface. The coating obtained in this way adheres to the metallic surfaces to the thickness of about ⅛ inch. A very simple arrangement is employed to obtain a magnetic field for the control of the arc. The strength of this field is dependent upon the current flowing through the lamp, which gives an automatic character to the magnetic regulation.

The color of the light can be regulated almost at will by the use of proper materials in the arc. The light from the lamps exhibited in New York is particularly agreeable, the character of the illumina-

FIG. 3.—BREMER LAMP, PLAZA HOTEL, NEW YORK.

tion furnished being somewhat between that from an incandescent lamp and from an arc, lacking much of the redness of the former and the glare of the latter. Some experiments made last summer at the Laboratoire Central de l'Electricite in Paris showed that for a given total flux of light the efficiency of the lamp is about double that of the ordinary arc lamp, the exact ratio being 200 to 117. In view of the fact that all of the light is distributed in useful directions, the comparison in favor of the Bremer lamp is even more favorable than these figures imply.

Opposing Federal Telegraphs.

Ex-Postmaster General Wilson S. Bissell, in an address before the Men's Club at Lockport, N. Y., roundly scored the agitation for government ownership of the telegraph. He said there are many reasons why the Government should not own the wires. The expense of management, he said, would be enormously increased because it would hardly be any time before the telegraph service would be extended to every little hamlet in the country. Every Congressman would want every corner of his district connected up by wire with the whole world. It would also throw into the employ of the Government many thousand more skilled workmen, which, he said, the Government should steer clear of. Mr. Bissell said that the Government made a great mistake by beginning rural free delivery, as the expense will far exceed the estimates and the service will isolate the farmers by cutting them off from social intercourse with their fellowmen at the country store and post offices. "What we want is postal savings banks, and not postal telegraph and rural delivery."

Telephony in Belgium.

Mr. G. W. Roosevelt, the active and efficient United States Consul at Brussels, Belgium, furnishes an interesting report on the present status of telephony in Belgium, as noted below: On account of dissatisfaction with the present flat rate system of telephone subscription (by which all subscribers are assessed alike for yearly local privileges), the Minister of Railways, Posts and Telegraphs has decided that it will be abandoned in favor of the more rational measured or message system, which is expected to bring about an enormous increase in telephonic communication.

As introductory, it may be said that, in 1895, at an expense of, roughly, $1,200,000, the Belgian Government obtained a monopoly of telephonic communication, absorbing the interests of the Compagnie Belge du Telephone Bell, the Compagnie Liegois du Telephone Bell, and various other small companies.

For telephonic purposes, Belgium is divided into 17 zones or areas, each with a large central exchange. These zones are not arbitrarily assigned, but allotted, and very successfully, to obtain the most efficient service. Nearly all the local service of Belgium is dependent upon the single-wire, non-metallic circuit system, but the Government is slowly making changes. The two zones of Brussels and Charleroi are now nearly entirely equipped with metallic circuits; the zones of Antwerp and Liege are under study.

A subscriber is entitled to communication with any other subscriber in the same zone, irrespective of distance; also to communicate over long-distance lines, at the regular rate, if he deposits at the beginning of each month an amount covering his estimated monthly expenses. He is entitled to telephonic delivery of telegrams which may come to him. The free delivery by telephone of telegrams is a great advantage and the privilege is almost universally used. Mistakes are very rare, and are guarded against with the utmost care, a key being furnished whereby words not unlike in sound may be clearly defined.

The flat-rate system of subscription varies considerably, in proportion to the magnitude and importance of the locality; thus, the Brussels and Antwerp rate is 250 francs ($48.25); the Charleroi rate, 200 francs ($38.60); and the rate in the five small exchanges built by the Government, 170 francs ($32.81), or for a three years' contract, 150 francs ($28.95); this is for a radius of 1 kilometer (0.62137 mile); longer lines in proportion to the length.

STATISTICS.

Total number of subscribers	13,620
Increase over previous year	1,277
Total length of wire (kilometers)	37,602
Increase over previous year (kilometers)	5,921
Total number of messages	47,224
Increase over previous year	5,668
Telegrams received and sent by telephone	1,443,474
Increase over previous year	165,648

Total receipts	$610,300.68
Total expenditures	462,249.58
Net profits	$148,051.10

The rate for interurban service is 1 franc (19.3 cents) per message of five minutes, irrespective of distance. The time may be doubled for 1.50 francs (29 cents), but for longer than ten minutes the rate is 1 franc (19.3 cents) each additional five minutes.

Rates for international service are for five minutes, and are governed by distance and the period of day or night. Thus:

Distance.	Day. *Cents.*	Night. *Cents.*
Up to 50 kilometers	29	17
50 to 150 kilometers	38	23
150 to 250 kilometers	46	29
250 to 350 kilometers	58	34
Extra 100 or fraction	10	6

Total number of messages	120,075
Increase over previous year	30,560

International trunk lines now connect with France, Germany, Holland and the Grand Duchy of Luxemburg. There are four direct lines between Brussels and Paris. A line with England is under construction. The land lines are now quite finished and the cable is being laid. All the international lines are of the metallic-circuit type.

In public telephones Belgium is woefully deficient, there being only 100 public telephones in the whole country; often in a large town there is but one such convenience. The rate for sending local messages is 5 cents for five minutes.

The 17 zones of telephonic operation cover about one-half of Belgium. It is unlikely that these zones will increase their areas to any great extent. The predominance of single wires will check any great great advance in the number of communications after the message system of subscription is instituted, and any increase in the use of the telephone will make the transformation in the matter of metallic circuits slower than ever.

The central bureaus are, for the most part, well constructed and along the lines of the most recent American practice. The great new exchange in Brusels, in particular, is a model of its kind. The simplicity of telephonic communication within a given zone is marked; each zone has one large central exchange, and, as a rule, nearly all the wires of the zone are directly connected with it. In this the Belgium telephone system has a great advantage over the telephone systems of the United States, where the distances are often so great that direct connection with one great central exchange is impossible. The absence of a large number of intermediate exchanges makes any increase in telephonic communication easy of control.

The Government has stated its intention to place all wires in the large towns in underground conduits, but the advance in this matter has been slight. The conduits adopted for Brussels are of vitrified clay pipes and are of American origin.

As to the out-of-door work in Belgium, as compared with that done in the United States, the only notable difference consists in the use of more iron structures—that is, more iron poles and iron fixtures. In Germany, Switzerland and Belgium expensive and ornamental iron poles are quite general in the cities.

Nearly all the instruments, exchange paraphernalia, etc., of Belgium are manufactured by the Bell Telephone Manufacturing Company, of Antwerp, and although this company is distinctly a Belgian concern, it is pleasing to note that its output is designed, with slight modifications, in accordance with the most recent American improvements. Most of the statistics given are for the year 1899, the most recent data obtainable.

Institute Meeting on Electric Railway Operation.

A very interesting and well attended meeting of the American Institute of Electrical Engineers was held on Jan. 24, devoted to electric railway work. After an admirable review of general traction conditions by President Steinmetz, a paper was read by Dr. Cary T Hutchinson on "The Relation of Energy and Motor Capacity to Schedule Speed in the Moving of Trains by Electricity."

This paper gives a thorough discussion, partly analytical and partly graphical, of the relation of energy and motor capacity to schedule speed. The problem is divided into three stages, viz., the determination of a velocity-time curve; the determination of a general motor curve sheet and the deduction from this sheet of several dependent curves, and the application of the general motor curves to the velocity-time curves. Equations are deduced giving a general solution of the problem involving the motion of a particle from rest to rest with three accelerations. The values of torque and speed in terms of input are plotted for some 20 different tramway motors of different size and make, but it is shown that the agreement is so close that one set of curves can with sufficient exactness be used for almost any railway motor built in this country.

The discussion throughout is based on the assumption that a motor operates at rated capacity on the one-hour basis, and will carry its rated output for 25 per cent of the total time. The average variation of core loss with speed is assumed equal to 41 per cent of the loss with rated speed.

The paper is accompanied by 15 curve sheets and a number of tables. An application of the principles deduced is made to the proposed express service of the New York Rapid Transit line. In this case the schedule speed would be 35 miles per hour, the average distance between stations about 7500 ft. and the time for stop at stations 15 seconds. Dr. Hutchinson states that under the assumptions of the paper it is practically impossible to acomplish such a schedule. The final conclusions of the paper are that the acceleration which gives the lowest motor capacity per ton is in all practical cases the most economical. A very small saving in voltage is not to be com-

pared with the many disadvantages of very rapid initial accelerations. Assuming for instance a gain of 10 watt-hours per mile for an acceleration of three over that required for an acceleration of one, in the case of a 20-ton car and with energy at ½ cent per kw-hour, this represents a saving of .1 cent per car mile, which is too trifling to be considered in comparison with the fixed charges on the greater investment for the motors and distribution system, the load factor at the power station, the increased cost of maintenance, the difficulty of accurate handling of cars, and above all, the much greater discomfort to passengers.

Mr. S. T. Dodd submitted a written discussion of Dr. Hutchinson's paper and contested his conclusion that the lowest acceleration possible under practical conditions is the best. A specific case was taken as an example, and the calculations made in connection therewith indicated that in that case the higher acceleration is the most economical, not only in power house but in equipment.

A written discussion of the paper was also presented by Mr. N. W. Storer, and is printed in full below.

A Consideration of the Inertia of the Rotating Parts of a Train.*

By Norman Wilson Storer.

THE problem of calculating the motor capacity and the amount of power necessary to maintain a certain train service involves a consideration of where all the power which is developed by the motors is expended; of just how much is used in overcoming train resistance; how much in overcoming the force of gravity, and how much in overcoming the inertia. The train resistance is a variable quantity depending on the track, bearings, wind and speed. A considerable number of formulæ have been produced to assist in calculating the train resistance under different speeds, but at the best the amount to allow for train resistance is only approximate. The energy required to overcome the force of gravity and the inertia of the train, however, is susceptible of the most exact calculation, but the latter part is seldom estimated correctly. There is one element in the inertia factor which has been almost entirely neglected, either because it has not been recognized at all or because its importance has not been appreciated. This feature is the inertia of the rotating parts of the train.

It has been generally understood that armatures of small diameter and light weight are desirable because their small flywheel capacity makes easier braking, but it has seldom been considered that this means also less power developed by the motor. A recent investigation of this subject has led to some very interesting results. It is found that the wheels with their low speed and the armatures, which usually revolve at a much higher rate than the wheels, together constitute an important element in the determination of the power required for operating the train. A specific instance will show this most clearly. Take the case of a double truck car weighing 30 tons loaded. It has eight 33-inch wheels weighing about 700 lbs. each, and two motors rated, we will say, at 150 hp each. The radius of gyration of the wheels is about 77 per cent of the radius of the wheel. The center gyration of the wheel, therefore, moves at a rate 77 per cent of that of the train. The flywheel effect of each wheel then is equal to a weight of $\frac{700}{.77^2} = 415$ lbs. whn reduced to the speed of the car. Eight wheels will, therefore, add 3320 lbs. to the inertia weight of the car.

The armatures have each a flywheel effect of 1400 lbs. at a radius of 6 inches. With a gear ratio of 18:53 the center of gyration of the armature will move a distance of 9.25 ft. for every revolution of the axle, or for a corresponding movement of the car of 8.6 ft. Its relative speed is, therefore, $\frac{9.25}{8.6} = 1.08$ times the car speed, and the flywheel effect is, therefore, $1400 \times 1.08^2 = 1640$ lbs. reduced to the car speed. The two armatures thus add an equivalent weight of 3280 to the inertia weight of the car.

The wheels and armatures together add an equivalent of $3320 + 3280 = 6600$ lbs., or about 11 per cent to the inertia weight of the car.

The following paragraph will show the effect of a change in the gear ratios:

With a gear ratio of 20:51 the flywheel effect of the armatures would be equivalent to the addition of 2400 lbs. to the inertia weight of the car. This together with that of the wheels adds a total of 5720 lbs., or about 9.5 per cent to the inertia weight of the car.

From a considerable number of instances that have been taken the flywheel effect of the rotating part of an electric car is found to average about 10 per cent of the inertia of the entire weight of the train. This means that 10 per cent more energy is stored in every train than is accounted for by the dead weight; 10 per cent more power is required for accelerating, 10 per cent more energy is lost in braking, and the train resistance measured by the retardation in coasting is 10 per cent below the true resistance.

The actual increase in energy supplied to a train on account of the flywheel effect of the rotating parts is the energy in these parts which is lost in braking. The relation this bears to the total power developed by the motors is dependent on the number of stops, the speed at the time the brakes are applied and on the energy absorbed by the train resistance. Where the stops are frequent, the energy lost in brakes may be from 50 per cent to 75 per cent of the entire power developed by the motors, in which case the energy required by the rotating parts will be from 5 to 7½ per cent of the total.

There are two simple methods for including this item in the calculations. The first is by basing the calculations on a weight of car 10 per cent heavier than the actual in determining the acceleration and drifting. The second is by assuming that the force required to produce a certain rate of acceleration is 10 per cent higher than would be necessary if it were simply a dead weight. This is probably the simpler method, as it gives round numbers for calculations, as 10 per cent added to 91.3 gives practically 100 lbs. per ton as the force required for accelerating at the rate of one mile per hour per second. All that is necessary then in correcting calculations for accelerations is to use this figure of 100 lbs. per ton instead of 91.3. It will give a good average correction, although if great accuracy is desired it will be preferable to calculate the flywheel effect of each of the rotating parts of the train separately. It will usually be found that for slower speed service, where the gear reduction is considerable, that more than 10 per cent will be required, while for high-speed interurban work where it would really amount to very little, anyway, on account of the small number of accelerations, the amount to be added for the correction will be less than 10 per cent.

As will be readily recognized this factor will also enter into the determination of the train resistance from the coasting line. Just how much of a correction will have to be made on this account depends somewhat on what is considered to be the train resistance. If this includes the friction in the motor then the train resistance obtained from the coasting line will be 10 per cent lower than the actual train resistance. On this assumption if the retardation in coasting is .2 miles per hour per second, the train resistance will be 20 lbs. per ton instead of .182 as calculated by the ordinary method. If, however, the train resistance does not include the friction of the motor the correction necessary to be made for inertia of rotating parts will be small, because it will be nearly balanced by the motor friction. When the train is coasting, the inertia of the rotating part is added to the inertia of the dead weight of the train in tending to keep up the speed, while the friction of the motor is tending to reduce the speed. When the train is accelerating, or moving with power on the motors, the motor friction is taken into account in the efficiency curve of the motor so that the train resistance to be used in calculating the acceleration should properly not include the motor friction. It will thus be seen that the error due to motor friction and the inertia of the rotating parts will tend to counterbalance each other in the determination of the train resistance from the coasting line. For accurate determinations, however, the train resistance should include a consideration of both the inertia of the rotating parts and the motor friction. The most accurate way to obtain this is to plot the friction curve of the motor and to obtain the inertia of the armature and wheels either from tests or from calculations based on the drawings.

It may be considered that this is an undue refinement, but if the matter is carefully investigated it will be found that the motor friction is quite a considerable portion of the total train resistance, in the same way as the inertia of the rotating parts is a considerable portion of the inertia of the train.

It is understood that general solutions for the railway problem may be offered which will give fair approximations of the motor capacity and the amount of power required. It is understood that any good engineer with a fair amount of experience can give a pretty good estimate of the power requird for a given service even when considering

*A communication presented at the January meeting of the American Institute of Electrical Engineers.

the capacity of the motor according to the old horse-power rating. But where accuracy is required, every known element should be considered at its proper value, and there will still be at least enough variable quantities in the railway problem. The most reliable estimate for train resistance should be used; the inertia of the rotating parts should be obtained and considered; the weight of the entire train should be known; the acceleration and power curves should be carefully plotted and the average heating effect in the motors should be accurately determined before any large equipment is finally decided upon.

Commercial Measurement of Electrical Energy.

At the recent convention in Milwaukee of the Northwestern Electrical Association, Mr. Elton J. King, of Fort Wayne, Ind., read a paper entitled "Some Important Points in Commercial Measurement of Electrical Energy," of which the following is an abstract:

Mr. King said that the manufacturers, generally speaking, have done much to aid in a satisfactory understanding between customers and central station men by simplifying the readings of dials and reducing the chance of error in computing bills. To the accomplishment of this end some manufacturers are offering counters with larger dial circles and are eliminating constants. In some of the earlier form of meters the use of constants was avoided on many of the sizes by varying the forms of the meter. This method, however, proved unsatisfactory because of the need of a very high speed to avoid constants on large capacity meters. The increased speed attained shortened the life of the meter and introduced large errors because the drag or retarding device failed to correctly drag the meter for required variations in speed. At present there is the almost universally accepted practice of designing the counter so as to retain the same maximum speed for all capacities of instruments and to eliminate the constant by changing the gearing of the counter.

In applying a constant of this character two methods present themselves. The first, by leaving the values of the dials of the counter remain the same as on smaller capacities, and multiplying the reading by the constant 10, 100, etc., depending on the capacity of the meter. For convenience the constant could be placed on the counter. This method, however, presents similar objections to the old method of constants for each different capacity meter, by leaving, to some degree, the same confusion and misunderstanding in the customer's mind, and requiring the repeated application of the constant in the records and in computing bills.

The second, and more advisable, method is to advance the value of each dial of the counter and thus avoid entirely the use of the constant. For example, instead of having the counter read to one-tenth of a kw-hour, as the smallest unit, advance the values of the dials by 10, 100 or 1000, making them read in 1, 10 or 100 kw-hours as the smallest unit, depending on the capacity of the meter. The first consideration of this method might seem unsatisfactory and open to objection as having a tendency to introduce confusion in the reading of meters, and lead to large errors due to the changing of dial values. This objection, however, is reduced to a minimum when we consider that meters that will develop a power of from 30 to 40 milimeter-grammes at full load, will successfully drive direct reading counters reading to one-tenth of a kw-hour as the smallest unit, on meters of 7500 watts (ampere-volt) capacities or less. Meters of these capacities can be made direct reading without changing the values of the dial circles or reducing the maximum time capacity of the counter to an objectionable amount. As it is possible to drive direct-reading counters of so large a capacity without changing the dial values much of the objection that might be presented to this method is eliminated. This is very forcibly illustrated when we consider that in practically all of the meter installations 97 per cent of the meters installed have an ampere-volt capacity of 7500 watts or less. This much has been done on the part of the manufacturer to provide a simple counter to assist in meeting the intelligence of customers and to aid the central station men in establishing a uniform and common unit upon which to compute and render bills.

The losses due to incorrect registration in many of the large stations reaches a percentage of from 12 to 20 per cent after the line corrections have been made and in many of the smaller stations these percentages are much larger. This discrepancy can be directly attributed to the slowness in registration of the meters. The small plant is the one which can least afford to stand a large slow meter discount, as the measured energy is generally distributed over a large territory and measured in small quantities. In a few of the large plants in this country this question is receiving careful attention and a corps of meter attendants is in charge of the meter service.

Broadly speaking, there are two methods of testing meters in general practice. The practice of testing meters in the shop and substituting them in place of meters about which complaints have been received or concerning which a suspicion of inaccuracy exists on the part of the company, is perhaps the most generally used method. There are several companies, however, which have competent meter attendants who check the calibration of the instruments installed in service. Either of these methods is fruitful of good results if carefully and intelligently carried out. By carefully calibrating the light load accuracy of the meters a large percentage of the meter loss can be eliminated, and for this reason it is suggested that a more frequent inspection of the light load accuracy of a meter be made. This inspection could be easily and quickly conducted to a fair degree of accuracy by an inspector provided with a standard lamp, a stop watch and an indicating voltmeter. Provisions could be made for inserting the lamp in circuit where the meter is installed, and it would require but a few minutes to check the calibration of the meter and make any necessary corrections on light loads. This class of inspection could be conducted at much smaller intervals of time than the regular or more thorough examination. In many cases we believe that this class of inspection could be conducted with good profit at intervals of from 4 to 6 months, depending upon the conditions under which the meter is installed, followed with a more thorough examination of the meter at intervals of a year and a half or two years. With means at hand for renewing wornout parts, such as the jewel and shaft, the meter attendants should be able to keep the meters in reasonably accurate calibration.

Mr. Gille mentioned the practice of his company of calibrating meters while on the line, using indicating wattmeters, and considered this one of the most convenient ways to check up a meter on the system that he knew of. Mr. King said that calibrating meters with indicating standard wattmeters is really the best and most accurate method of accomplishing results. The use of a standard lamp for checking a light load is convenient for the small central station people, as it can be done very quickly, but it is certainly advisable to install meters so that they can be checked with the standard wattmeter, and if meters can be installed under such conditions, the use of a standard wattmeter would be much preferable to the use of a standard lamp.

Professor Jackson was sorry to see the use of a standard lamp and indicating wattmeter recommended for testing meters on light loads, because it was a slovenly method. When the meter expert of a manufacturing company advises the central station man to use that method, he will use it, and he was sorry to see such advice given. The indicating wattmeter costs no more than the indicating voltmeter, and every central station should have indicating wattmeters for checking its recording meters. If a station does not feel that it can afford to have a sufficient number to test all sizes of meters under varying loads, it certainly ought to have one that would cover the light loads on all meters, a medium load on the average meter, with perhaps whole load on the average meter. In reply to a question as to the practice of checking total output with the amount of current sold as shown by the meter at the consumer's and the proportion those amounts are and how they vary with respect to direct and alternating currents, Mr. H. C. Wirt gave some data. In a particular case the kw-hours produced at the switchboard for commercial lighting only were 729,923 by meter, and the kw-hours registered by meter at consumer's lamp installations were 309,001 kw-hours, showing a loss in transmission of 58 per cent, leaving available for sale 42 per cent. Part of this, of course, is line loss, part accounted for by slow meters, and a large part core loss. In another case the figures were 671,006 kw-hours and 393,222.6 kw-hours, respectively, showing a loss in transmission of 41½ per cent, and leaving available for sale 58½ per cent. This latter refers to an Eastern station, and is not any worse than probably some of the Western plants. Mr. Williams said that at the Madison station there are both alternating and direct-current meters on the switchboard, and all consumers have meters. The losses are separated out of our losses, including the core losses, transformer, meter and shunt losses, etc., both for the direct and alternating currents. The consumers' meters, as compared with the registration of the station meters, register from 75 to 80 per cent, and on the direct-current and power system is from 85 to 90 per cent; the transformer core losses are from 5 to 7 per cent of the output, and the meter shunt losses run from 3 to 5 per cent on the alternating. That brings the loss unaccounted for down to about 10 per cent.

Professor Jackson, referring to a remark by Mr. Bowen, said it is not wholly a question of sales per pound of coal that interests

the station, but it is the sales per pound of coal plus the cost of labor and interest. Now, when you come to take that extra item into account it makes station wattmeters of more value, because they decidedly influence the management of the station. Moreover, the station wattmeter when used properly in conjunction with the readings monthly of the consumer's wattmeter, enables the station manager to arrive at a point at which he should attack his losses, and can attack his losses with the greatest success. But the fact is more work is done toward improving the steam engine in the station to the last economy, than in all the rest of the plant put together, yet the steam engine is the place where the least can be gained ordinarily for a given amount of expenditure of labor and money. The station wattmeters will go further than anything else towards enforcing the lesson upon the manager's attention that it is not the engine that is at fault, but it is the fireman that is at fault, that his transformers are at fault, that his meters are at fault.

Mr. Doherty called attention to the fact that we must know where our losses come in to correct them. You can calculate the core loss of your transformer to reasonable accuracy; you can also calculate the shunt loss of your meters and the resistance loss of your lines, and the difference will represent your theft of current and the faulty registration. If you do not separate out the core losses which are a constant, regardless of the amount of current you sell, your real, unaccounted-for current will vary considerably in different months in the year, on a percentage basis, because in the winter time your lights will average more than an hour's use in Western central stations, and in the summer time they will average less than an hour; the maximum may be as much as four times greater than the minimum. With a transformer capacity equal to the connected load, a core loss of two per cent alone amounts to 10 kw-hours per lamp per year. The average use of lamps in these Western central stations is about 18 kw per year. Among those lamps there will be many that do not use 1 kw-hour per lamp per year, but you must send from the station 11 kw-hours to supply that, so you are getting from the consumer a return of not 20 cents, but less than 2 cents per kw-hour. If a man uses 18 kw you are sending from your station 28 to supply him, and if you are getting 20 cents a kw-hour for current sold, you are getting 16 or 17 cents per kw-hour for current generated.

The measure of a good meter are cost, ease of repair, ease of installation, etc., and in addition to that other factors must be considered. In a general way, the meter should be as light as possible; second, the moving parts should be as light as possible, because the weight of the moving parts has most to do with the wear of the jewel; the meter should have a low-shunt loss, for the sake of economy. All of the alternating-current wattmeters have so low a shunt loss that it is not important. Figuring labor and fuel at one cent per kw-hour, you have a cost for one wattmeter of 8 cents per lamp per year for the item of shunt loss, and for the two wattmeter installation it amounts to about 16 or 17 cents. The greatest objection to shunt loss is the fact that much heat is dissipated in the meter and must be gotten rid of, and the maximum capacity of the meter is dependent more largely on the amount of heat which must be dissipated than on any other one factor. The average induction meter is good for 300 per cent overload, and some of them for 700 per cent overload. There are two sources of heat generation in the meter; one is from the shunt loss, and the other from the drop in the series coils. There is also a reactance drop that does not cause heating, but does affect your regulation. The drop in the series coils is the most important point in selecting a meter. Its regulation affects the capacity of the meter, and there is no advantage in a meter having a large drop in the series coils.

As to the desirability of a high torque meter, as the net torque must be the same in all cases, and as the meter with high torque must be compensated for by the extra drag in the magnets, there is no advantage in it. Concerning the question of reducing the loss between current generated and current sold, this is a problem in transformation, transmission and metering. As a rule, the resistance loss of an alternating-current system is not heavy; the core loss, while but a small percentage of the total capacity of the station, yet amounts to considerable if the quantity of current used is large, because this loss goes on practically the same for 24 hours per day. This is also true of the shunt loss in meters. With modern induction meters it is possible to register the current to a point of accuracy which leaves very little to be desired. The present induction meter with dust-proof case and with light moving parts, well built to start with, with permanent magnets that are permanent, should run three to five years without any attention whatever. As to transformer core loss, Mr. Doherty said he has succeeded in getting good results in central stations by systematically overloading the transformers.

In Madison the core loss is .54 of 1 per cent on connected load, and that is why Mr. Williams is getting the high efficiency he has just mentioned, which apparently are from a December report. In December the lights are used for long hours, and, therefcre, the percentage goes down, and it increases in the summer time. An average of the year for that station is about 73 per cent for alternating current.

Where individual transformers are used practically 100 light transformers should be employed. Where transformers are connected up together, the transformer capacity can be gotten down in some districts to 25 per cent of the connected load, and in the city often as low as 33⅓ per cent. It makes a great difference whether you have got 33⅓ per cent capacity in transformers wasting current or whether you have got 100 per cent, and it is largely a problem in capacity of transformers which must be considered together with other possible core loss. Core loss is, as a rule, the big source of loss in an altternating-current station. Mr. Doherty expressed himself a firm believer in more exact regulation than any direct-current station that was ever buil in transmitting current over any considerable area.

The Storage Battery Automobile.

Mr. H. P. Maxim recently delivered an interesting lecture before the Automobile Club of America, in which the present status of the gasoline and storage battery automobile was discussed in detail. Two inherent disadvantages of the former are noted—it cannot start under load, and it cannot be overloaded. In detail, the gasoline automobile engine of to-day stands wanting in ignition apparatus generally, in the proper proportioning of number of engine cylinders, engine horse-power and gear change, in friction clutch constructions, and in not providing in ordinary machines intended for the public the automatic governor.

Taking up the electric automobile, Mr. Maxim considers that there is generally more prejudice and less knowledge concerning the electric storage battery, and what it will honestly do and what it really requires, than any other piece of automobile apparatus that is one-half as much used. We continually hear broad and sweeping condemnation in one breath, and amazing claims of mileages and capacities per unit of weight in the next. As a matter of fact, the general lack of knowledge concerning the storage battery has caused and is causing it to suffer just the same as has been the case with the gasoline engine.

In the beginning the lack of knowledge of its necessities and care, even on the part of the manufacturer, caused it to turn out in practice just about as far from what we originally had the right to expect as anything could. But again, notwithstanding all this an addition of the public prejudice added, the many extraordinarily advantageous features of the system of which it was a part, prevented its being kept down. To-day we have in it a piece of apparatus which, while far from perfect, yet possesses possibilities which compel its consideration.

As an example, the best automobile storage battery we could buy three years ago and be sure of getting had a maximum capacity, at a certain discharge rate, of 2½ ampere-hours per pound of complete cell. This meant that with a vehicle of the style and general characteristics then demanded, the maximum weight of battery that it was practical to put into it could not in every-day service be counted upon to average more than 20 miles on one charge. It had, where it could be treated individually, and with skill and understanding, relatively few ailments, and could be counted upon to have a life of about 100 vehicles discharges before losing 50 per cent of its original capacity.

To-day, barring patents, we can buy batteries, which have a capacity at the same discharge rate per pound as before, of 4½ to 5 ampere-hours per pound of complete cell. This means that twice the mileage is to-day obtainable in the same vehicle and with the same weight of battery. But what is more important, the positive plates of these batteries (which are the minimum life factor) will give, where certain well understood and easily avoided abuses are not practiced, a life of at least 125 complete vehicle discharges, without losing any of their original capacity. Taken as 40 miles per discharge, this is 5000 service-miles that the storage battery of the best type of to-day can be absolutely counted upon to give.

When we look for the causes of this improvement we find satisfactory and reasonable ones. The battery plates are made with many times more active material upon them. They are provided with sepa-

rators which not only give plate separation, but form a veritable lock for the active material, absolutely preventing its escape from its plate. The plates and these separators and many details about the jar, are carefully proportioned so as to ensure that the combined element, when it is in place, forms a solid, self-supporting structure. Except by the most violent formation of gas is it conceivable that any of the active material can get away from the plates.

As an instance of the effectiveness of this construction, which is becoming common in all the best types of pasted batteries, I have seen several of them after the completion of the 100th discharge. The separators were actually an integral part of the plates. They could not be removed without taking the active material off in large sections. This certainly made it seem evident that one of the most serious difficulties in past batteries has, in these latest types of storage batteries, been permanently overcome.

The constructional features of the grids do not seem to affect, to any material extent, the capacity per pound, provided they do not present an unnecessary amount of dead rot. They do affect the life, however, since if the positive grid is so arranged as to leave important parts too much exposed to oxidizing action, it is soon weakened enough to break, lose conductivity and suffer permanent and serious reduction in capacity.

The separators, which seem to be chiefly responsible for the increased practicability of the recent storage battery, are usually in all of the different types, made of thin wood. They are cheap, porous, very slowly affected by acid, and when made with small vertical ribs, furnish the necessary separation for acid space between the plates, and furnish an admirable surface for holding the active material closely against the grids.

This, of course, as far as it goes, promises us practicaly results. But, nevertheless, even with all these, and the many small detail improvements, which we have not time to consider, our automobile storage battery is still wanting, if it is open to injury by ignorance or carelessness in charging—the cause of most of the injury of the past. Violent overcharging would burst off anything.

This point has been met by an automatic charging outfit, which has appeared recently on the market. It is provided with a resistance, marked to suit the different standard makes of electric automobiles, and when used in conjunction with suitable current, automatically sets a rate which is safe. Then, when the voltage across the battery terminals indicates that the maximum safe amount of charge has been given, it automatically cuts out.

Our batteries thus, either in the owner's stable or in a garage, need no longer be dependent upon the watchfulness and knowledge of an attendant for their correct charging. Our past experiences have proven that this cannot but have a most advantageous effect, and still further add to the practicability of our automobile storage battery.

There seems to be every reason, therefore, for believing that our present automobile storage battery, as our manufacturers know how to produce it, and to protect it, is to-day, even in untrained hands, as practical a piece of automobile apparatus as we have before us.

The tremendous importance of anything that will tend to increase the practicability in general, of the automobile storage battery, is realized when we consider the motor system it makes available to us.

Nothing that has ever been devised comes anywhere nearly being as suitable for traction purposes as the electric motor. It is able to start under any load, able to accept any over-load up to the point of actually burning up, is of ideal mechanical simplicity and suitability for connection to the driving wheels of a vehicle, absolutely automatic in its running, and independent of any consideration, preparation, mechanical knowledge, or skill on the part of the driver of the vehicle it propels other than that necessary to guide it.

Mr. Maxim spoke of the great assistance the Automobile Club of America could give the American public, as a whole, by undertaking a competitive trial of automobile storage batteries, and to make the results public in an unprejudiced way. It is now an entirely practicable thing to get plenty of good batteries, and, of course, we know how to make a practical test of them. The storage battery is not an expensive piece of apparatus to make in quantities of two or three, and besides the manufacturers there are many electrical engineers and electro-chemists who would welcome an opportunity to publicly demonstrate their ideas on storage batteries, if they could feel sure that their efforts would receive whatever credit were due them.

In conclusion, Mr. Maxim dwelt on the bearing of the two powers, electricity and gasoline, upon each other. He considered that the utilitarian conditions which each power's characteristics enables it to best meet, will determine absolutely its respective field, the word "utilitarian" being employed both in a pleasure, as well as a business sense. In Europe, and in France especially, the utilitarian is not recognized, and in this respect we have gained in the past and will gain in the future. The generally more effete and less practical instincts of the European have caused the sporting element—in the aristocratic European understanding of the term, a thing which we in this country scarcely grasp—to be the dominant factor.

In no European country has the success followed attempts to produce and encourage the utilitarian automobile that has followed in this country. Witness the number of automobile business wagons taking a legitimate part in our daily city service, as compared with the case in Europe, and our automobile cab service right here in the city of New York, as compared with similar attempts in London and Paris.

The European may invent, but it is the American who reduces to practice. It is the indomitable national instinct of utilitarianism, even in our pleasures, that Americans possess, which is going to successfully develop our gasoline, electric and steam automobile, lead them into the fields best adapted to their several characteristics, and ensure their superiority.

The electric will absolutely, certainly dominate wherever comfort and convenience in transportation is demanded, and where absolutely no consideration of the vehicle is possible other than that necessary to guide it. Gasoline will absolutely dominate wherever a ton-mile must be accomplished at the minimum of expense, and wherever distances exceed the practical limitations of the storage battery. Mr. Maxim believes that the final automobile will be the product of the American engineer and mechanic, just exactly as have been the best steam locomotives and the best street cars.

Behr Electric Monorail in Germany.

Before the Association of German Engineers, Mr. F. B. Behr has recently delivered a lecture on the high-speed monorail road authorized between Manchester and Liverpool, and on high-speed electric roads in general. The German Imperial Railway Department and technical personages of note manifested great interest in this subject, and many eminent men were among the audience. The president of the Railway Department, Dr. Schulz, with Herr Streckert and Herr Schroder, two other of the highest railway officials of the empire, were present. Among others were Professor Slaby, Professor Riedler, Herr Kemman (technical adviser of the Deutsche Bank), Herr Wittig (director general of the Elevated Railway), and a representative from the British Embassy. In the course of his remarks Mr. Bahr alluded to the experiments now being carried out between Berlin and Zossen, and said:

"The feature of high speed, and especially the creation of a type for the introduction of high-speed railways, seems not to have been to my mind the principal object in the minds of those who have investigated these experiments. If I may be allowed to say it, with all diffidence, however successful from an electrical point of view these experiments may be, and no doubt will be, from a high-speed railway point of view—quite distinct from the electrical working—it seems to me that they cannot lead to any final result. Working on a practically straight line they can never produce a type to be adopted generally for high-speed traveling. This I have fully explained in beginning my lecture, and in this I am fully confirmed by the experiments themselves. If a two-rail line cannot be absolutely safe in theory, no experiments can prove it to be so; and, further, when you compare the weights and results, as far as I know them, we find that the carriage used of a weight of 94 tons, and carrying 45 passengers, used 3000 hp during the acceleration and 1000 hp on the rest of the journey. These figures are more than double those which will be used on the Manchester-Liverpool line. The carriage sanctioned for the Manchester and Liverpool line weighs 39 tons for 38 passengers, and uses 515 hp, against 94 tons weight of carriage at Zossen for 45 passengers, with an average horse-power of 1100, and an accelerating horse-power of 3000. This means at least double the consumption of electricity per passenger and double the amount generated at the generating station. The height of the carriage without the trolleys is 14 ft., as far as I can judge from the drawings against mine, which is 11 ft. With the trolleys it is practically double that of mine. The same thing applies to the weight of the structures over which the train runs, as, per foot of bogie, the weight of the Zossen carriage is nearly double that of the Manchester and Liverpool line. This also applies to the pressure per sleeper, which is also 17 tons at Zossen, against 9½ at Liverpool."

Electric Canal Towage in Europe.

With regard to the familiar efforts that have been making to apply electricity to the European canals, a cable dispatch from London, of Jan. 11, says: Frank W. Hawley, vice-president of the Erie Canal Traction Company, has been on this side several months quietly securing concessions for the operation of European canals by electricity. The Erie concern to-day secured control of about 5000 miles of canals in England, and on the continent. As a result cargoes will shortly be shipped on the same bill of lading from Duluth, Minn., to Brussels, Bruges, Ghent and Cologne, and later to many points in the United Kingdom, France, Germany and Italy.

At the forthcoming session of Parliament the British legislators will be asked to grant permission for the erection of central power stations for the propulsion of traffic on at least two British canals. These will be operated with American capital, though their control will nominally remain in British hands.

Mr. Hawley gave an interview to a representative of the Associated Press as follows:

"It is true that the traction company is making considerable progress in securing all-water routes by electrically operated canals throughout Europe. I cannot tell you yet the names of the English canals which will figure in Parliament. There are in the United Kingdom 1138 miles of canals owned by railroads which do not make a very good financial showing, but 2768 miles of English canals, independent of railroads, show earnings of £729 a mile, which is greater than that shown by many American railroads. However, we have been able to get control of a portion of these, because their operation and maintenance expenses are over 70 per cent of their gross receipts. The largest canals in England—namely, the Birmingham, Grand Junction, Leeds and Liverpool and Oxford and Bridgewater—are not far removed from sources of electric power supply, at least, nothing like so far removed as is the canal at Oakland, Calif., where the power is transmitted from the Yuba River, a distance of 140 miles. Therefore, it is merely a question of getting the necessary consent of Parliament for the conveyance of this electric energy before the English canals will be equal to the canals of America and Belgium, where electrical energy has resulted in increased facilities with a corresponding reduction in the cost of operation."

The officers and directors of the Erie Canal Electric Traction Company, according to a recent list, are Louis A. von Hoffmann, of L. von Hoffmann & Co., president; Frank W. Hawley, vice-president; A. B. Donaldson, secretary; Charlton T. Lawis, John G. Carlisle, Thomas C. Platt, Frank W. Hawley, Alfred S. Heidelbach, of Heidelbach, Ickelheimer & Co.; William H. Baker and James Virdin. The Alden motor towage system of Mr. H. N. Alden, controlled by them, has been described fully in these pages.

French Criticism of the Weaknesses of Wireless Telegraphy.

In the discussion of the relative merits of wireless and submarine telegraphy, Messrs. Boulanger and Ferrier, two French army engineers, offer the following considerations:

1. Insecurity of communications.

2. Necessity of constructing very high supports for the antennæ, from the moment that the distance to be covered is at all great.

3. Cumbersomeness and sensitiveness of the apparatus.

The first of these objections is the most serious, and, unfortunately, so far, it does not appear to be possible to remove it entirely. If the fact that messages can be intercepted is not a very important objection, owing to the possibility of using cipher codes, the same cannot be said about the fact that the reception of a mesage can be interfered with by a transmitter even placed at a considerable distance off. Moreover, in warm climates (and why not in warm weather anywhere?) the reception of telegrams can be very much disturbed by atmospheric perturbations.'

The necessity of employing very high supports for the antennæ is no great objection on shipboard, where, moreover, there is no occasion generally of corresponding at great distances. But such is not the case when working from land.

As a rule, communications are more difficult over land than where the stations are separated by water. It was thus that the trials made in the Transvaal gave no practical results. Good communications can, however, be had on land with sufficiently elevated antennæ. But, beyond 50 to 60 meters in height, the construction of supports presents great difficulties. Recourse must, then, be had to captive balloons; but these are at the mercy of the winds.

It follows, therefore, that the progress obtained by Mr. Marconi, though important, does not yet allow wireless telegraphy to supersede the processes hitherto in use. Whenever possible, it will always be preferable to employ existing methods, which possess the great advantage of simplicity. Nevertheless, in many cases, wireless telegraphy will be a precious complement to the other, and ought not, therefore, to be neglected. At sea, for instance, it would often be the only means of communication, and it is easy to imagine circumstances when even on land no other means of telegraphing would be available, especially in military operations.

It is in this field that the practical use of wireless telegraphy must be sought, and the progress accompanied since its inception warrants the hope that the aim of its adepts may soon be attained.

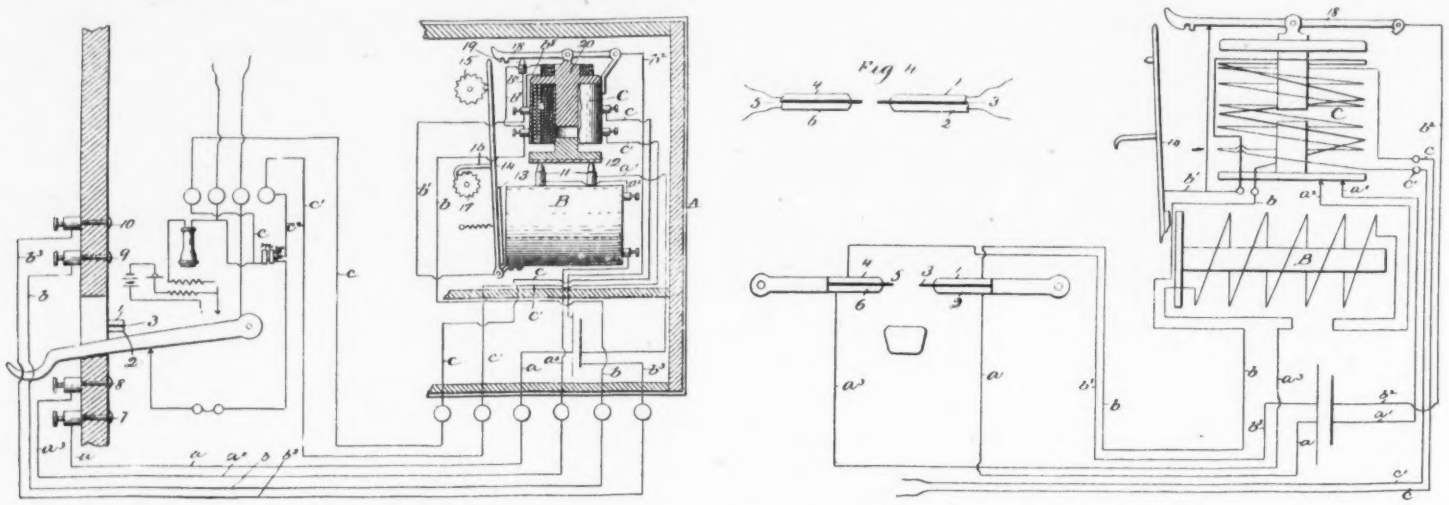
Electrifying the Water Powers and Railroads of South Africa.

War is not the only thought in men's minds in South Africa. Professor J. T. Morrison (Professor of Physics at the Victoria College, Stellenbosch) has just delivered an interesting lecture in Cape Town upon "The Development of Water Power, with Some Reference to South Africa." In his opinion, South Africa possesses, in the Orange River Falls, the source of far more than sufficient convertible energy for working the Cape Government railways. They are not the only falls capable of being so converted, but he selects them as being the most suitable for this purpose, in spite of their rather inconvenient situation. Cape Town is distant from them 400 miles, Port Elizabeth and East London between 400 and 500 miles. The question, he said, was whether or not it was practicable from a financial point of view to transmit power 400 or 500 miles, and make it pay, and was it a question which the Government could take up and deal with as a matter of policy? He ventured to think it was, notwithstanding the circumstance that were the scheme entered upon it would entail the longest transmission of power yet attempted. He proceeded to quote facts in support of his contention that such a scheme would be financially profitable. Taking the returns of the year 1897 as a basis, he found that the Cape Government Railways used something like 10,000 hp. That would mean 50 engines in constant use, but the probability was that 100 were used. These would be of 200 hp each. The cost of fuel in 1897, without wages or anything else, was £299,000, representing a cost of £30 per horse-power. In transmitting power 400 miles, the capital cost would be distributed as follows: Works at the falls (which are 200 ft. high and capable of producing 30 times the power required) would cost, at an outside estimate, £180,000; 400 miles of copper wire to carry 40,000 volts would represent 5000 tons of copper and would cost £400,000; the erection of the transmission line would cost another £180,000. But the power could not be used at the high pressure of transmission, and it would also have to be used in motors of 200 hp each. The cost of this would be £600,000, making the total cost £1,360,000 ($6,800,000). Nothing depreciated so little as hydraulic machinery, and only 4 per cent per annum need be written off for this (a very high rate), equalizing £54,400, which with 5 per cent interest on £68,000, made a total annual expenditure of £122,400 ($612,000). Comment on the comparison between this and the present cost was needless. The change from steam to electrical power could be effected with ease Steam and electric engines could run on the same line, and as the former fell out of use they could be replaced by the latter. There were, he continued, certain parts of the line on which the power from the Orange River Falls would never be used. For example, it would not be necessary to transmit that power to Cape Town, as there were sources of power in the neighborhood. The Wynberg line could be worked from these sources. It required a little less than 1000 hp. There were sufficient available running streams close at hand from which the power could be derived. It would not be difficult to get 400 or 500 hp from the Stellenbosch district, while there were many other sources, like the Witte River, for example. Moreover, the Wynberg line, being a busy line, would be an excellent one on which to try the experiment.

New Telephone Patents.

There are three telephone patents in the issue of Jan. 21, two hailing from Germany and the third curiously enough from Germany's nearest neighbor in this country—Hoboken. Another coincidence is that two of the patents relate to service meters. The trend of telephone practice, in the aim to make low rates and extend the development of the telephone by party-line and message rate service, is strikingly represented by the numerous patents that issue on party-line systems and service meters. The evolution of working systems, however, seems to require the production of many that will not work—outside a laboratory—and of many that are devised wholly without regard to the practical conditions that govern the commercial supply of telephone service. A similar waste of effort occurs in every phase of life, from the works of nature to the products of the mind of man, so there is little profit in protesting.

The American patentees, Messrs. Robert and William Hammatt Davis, of Washington, D. C., and Mr. Daniel C. Woodbury, of Hoboken, patent a recording system for use in connection with any sort of apparatus where it is desired to record either the total time or the number of times that the apparatus has been in use, or both. The invention is specifically described as furnishing a telephone meter to be used at sub-stations, though its use is not so limited, and certain features of it are considered capable of much wider application. The inventors consider that a telephone service meter should be entirely automatic, not requiring any special act on the part of the subscriber to operate it, that the placing of meters at the exchange is objectionable because of the complication of wiring, the demand on space, and because the subscribers prefer to have the meters under their own inspection "to do away with any possibility of fraudulent overcharge by the telephone companies."



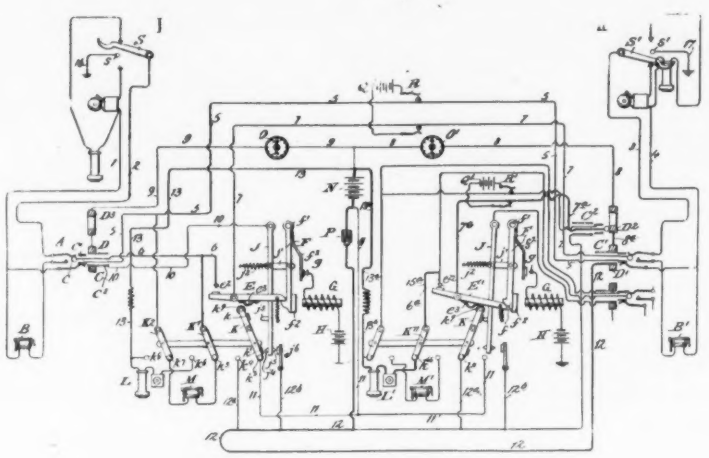
FIGS. 1, 2, 3 AND 4.—DAVIS AND WOODBURY'S TELEPHONE RECORDER.

Referring to the diagrams, Fig. 1 shows the system applied to a magneto telephone system, Fig. 3 is a diagrammatic view of the recording system and Fig. 4 is a detail view of a contact device by which the switch-hook automatically closes the circuits of the meter in its rise and fall, shown in Fig. 1 as projecting into the opening in the side of the telephone box. One of these contact pieces is placed on each side of the opening and projecting into the path of the switch-hook. They are composed of two strips of conducting material, as 1 and 2, separated by a flexible strip of insulating material, as 3. Strip 1 is connected to binding-post 9, strip 4 to binding-post 10, strip 2 to binding-post 7 and strip 6 to binding-post 8. When the switch-hook rises it makes contact between 2 and 6, but in passing bends back the insulating strips and so does not make contact between strips 1 and 4. When the hook descends contact is in like manner made between strips 1 and 4 and not between 2 and 6. When a subscriber uses his telephone, the hook in rising closes 2 and 6, making the following circuit: Strip 2, post 7, wire a, battery, wire a^1, contacts 11, closed by a plate on armature 12, wire a^2, magnet B, wire a^3, post 8, strip 6, back to 2. Magnet B attracts armature 13 attached to lever 14, which releases wheel 15, allowing a time-recording device to start; at the same time arm 16 moves wheel 17 one point, recording the call. Lever 14 is held in position by a notch in lever 18, in which it engages when attracted by B. When the conversation is finished the downward movement of the switch-hook closes contact between 1 and 4, making this circuit, strip 1, post 9, wire b, one coil of C, wire b^1 (b^4 being broken as 18 is held away from contact 19 by lever 14) lever 14, 18, wire b^2, battery wire b^3, post 10 and by 4 and hook back to 1. This energizes magnet C, repels armature 20, raises 18 and releases 14, which stops the time-recording device. Armatures 12 and 20 are polarized, so that current that repels 12 will also repel 20. When a sub-station is called by the exchange, the calling current energizes circuit cc^1, which is in shunt to the armature of the magnets, and contains the second winding of C; C then draws up 12, thus opening the circuit aa^1 at contacts 11, so that when the switch-hook rises in response to the call B will not be energized and no call will be registered. When the hook is depressed C is energized through circuit b^4 and repels 12, thus re-establishing the connection between contacts 11, and leaving the recording device in condition to register another call.

Further modifications of the system are shown illustrating the application of the system to common battery work, and describing a time-lag controlling device to enable the subscriber to call a second time for the same connection without repeating the record on the meter. The device, however, stands little chance of adoption in practice, as apart from its complication and expense and the doubtful feature of the whole working depending on the integrity of the flexible insulating strips to be bent to and fro every time the hooks moved, a meter such as this meets the fundamental difficulty that it would register every call while telephone rates are based on completed connections.

Herr Georg Ritter, of Stuttgart, Germany, patents a telephone system relating in particular to a register and testing system for telephone exchanges. The principal feature of the invention is of course the service meter, which Mr. Ritter places at the central office and so arranges that it will operate only when the called subscriber has taken down his telephone, thus registering completed connections and not merely calls. To accomplish this object, however, Mr. Ritter indulges in a combination of listening-key relay and interconnected levers of somewhat ferocious complexity, and which would require to be of very solid and accurate workmanship to perform effectively all that is required of them. This arrangement is shown in the diagram, where KK^1 K^2 make up the combination listening key and circuit changer, connected by an insulating connecting rod K^2 and G is a relay controlling the lever F connect to lever J by an insulating link and controlling contact lever J by means of the latch f. Each sub-station has a ground connection 16, 17, with contacts ss^1, over which the switch-hook passes to operate relay G which is connected in a grounded circuit made up of line wire 3, plug-tip, wire 7 levers E and F, spring f^3 and through coil, battery H to ground. The meter circuit is the principal point of interest. O represents the meter of calling sub-station I. The circuit, starting from the jack-ring D is made up of wire 9, meter magnet, battery N wire 11, lever J and wire 10 to socket C^2 of the calling plug. Normally the circuit is open of course between the plug and the jack, and when the plug is inserted and contact between C^2 and D closed it is still open at K^1 on lever K and j^4 on lever J, which have to be brought together to complete circuit between wires 10 and 11. When the operator

answers a call she moves the triple lever key so that K^1 rests on K^3 and K^2 on K^4; this throws her telephone in circuit and also, by the action of roller K^5 at the end of K on bent spring e^3, throws lever E up into engagement with latch f on lever F, held forward from G by the spring j^3. Having obtained the number she throws the triple lever key to the position shown in the diagram and so brings the contact K^1 on lever K opposite contact j^4 on lever J. When the called subscriber takes down his telephone he momentarily grounds line 3 and so energizes G, which attracts f^3 and consequently F, releasing the detent lever E; the rise of the left end of E closes contacts e^1 e^2 thus completing 6 7, previously interrupted at that point. The relay G being energized momentarily only the linked levers J and F are drawn away by the spring j^2 immediately after F has been attracted for the release of E, and j^4 then makes contact with k^1, thus connecting wires 10 and 11, which completes the local meter circuit through battery N and causes the meter to register. No call can be registered until the called subscriber has taken down the telephone. The device has been well worked out, but it is open to the objection that its operation would require the use of a rather complicated mechanical outfit which, since it is controlled by the listening key, must necessarily be placed in the switchboard. The system stands little chance of adoption in American practice. Mr. Ritter is also responsible for a patent covering a telephone exchange system which has for its object the automatic ringing of the called sub-station and the



RITTER'S TELEPHONE SYSTEM.

automatic interchange of the circuits of the operator's telephone and the disconnection signal in the proper sequence. The system has been worked out with extreme ingenuity, but it is excessively complicated. The general principle is the employment of a relay to operate the circuit-changing device, the relay being included in a local circuit completed when the plugs are inserted in the jacks, a third conductor in the cords being used for this purpose according to ordinary practice, so that the relay is energized when the two plugs are in. The automatic ringing device consists of a pair of mercury tube contacts, mechanically connected to the circuit changing levers controlled by the relay; the tubes are tilted by the action of the relay and the flow of the mercury subsequently maintains contact with the ringing-machine during the period of its flow back to its normal position in the tubes. The action of the relay is also automatically controlled by a mercury contact device. If all went well with Mr. Ritter's glass tubes and mercury contacts, all the operator would have to do would be to insert the two plugs, as this, besides connecting the two subscribers, starts the cycle of operations which automatically rings the called station and subsequently switches in the disconnection signal. Mercury contacts of such character, however, are not held in much repute by telephone engineers.

Yerkes in London.

A cable dispatch from London of Jan. 23 says: The *Times*, in one of its financial articles this morning, states that influential stockholders in the Metropolitan Railway have issued a circular favoring a union in the electrification scheme with the District Railway and the leasing of their line to the Yerkes company, with a guarantee of 3½ per cent on the ordinary stock. This seems to be Yerkes' final triumph.

A Decision On Appeal Against the Carty Bridging Bell Patent.

Judge Buffington, of the United States Circuit Court of the Western District of Pennsylvania, handed down a decision on Jan. 27 which was concurred in by Judge Acheson, finding that the John J. Carty patent of the American Bell Telephone Company is invalid. The Western Electric Company first commenced the litigation of this patent in 1897, bringing suit for infringement against the Millheim Electric Company. The Carty patent was then sustained in decisions by the local circuit court, and later by the United States Court of Appeals. A few months ago the Western Electric Company, backed up by this former decision, entered suit against the Anthracite Telephone Company, of Williamsport, Pa., asking for a preliminary injunction which was refused by Judge Acheson on the ground that the court had not heard all the facts in the Millheim case. In his opinion Judge Buffington first reviews the suit brought by the Western Electric Company against the Milheim Company, in which the Carty patent was sustained, then he explains the Carty patent in substance as follows:

The Carty device is of the multiple circuit construction, and at each station is a permanent bridge, in which is seated a bell magnet with a high co-efficient of self-induction, and of marked impedance. There are also two other bridges, normally open and closed only when the station is in use. The telephone bridge circuit normally open is closed in multiple arc with its own bell magnet, and, of course, with all others in the line when in use. The generator call circuit normally open when used forms a second bridge or cross-connection between the wires in parallel circuit with the bridge circuit of its own bell and those of all others in the line. In operation the tendency of the call current to short circuit is counteracted by using a bell magnet of high self-induction and impedance.

This not only prevents short circuiting, but effects a more even current distribution through the bell magnets of the entire system. By means of the numerous windings of the bell magnets the small portion of the call current passing, exerts a marked magnifying effect on the cores and a spirited working of the call signal.

The opinion then continues: Does such a combination involve a patentable novelty? The solution of this question turns on whether the placing in combination of these elements, all of which individually were old in the art involved, represents inventive genius, or was the natural advance incident to the application of electrical engineering skill to the solution of recognized difficulties. The general principles applicable to series and multiple are distribution of currents were known and utilized prior to Carty's alleged invention, and in a multiple arc system the current divides itself among parallel bridges in proportion to their several resistances.

It was known also that by the use of magnets of high impedance certain currents would and certain currents would not be allowed to pass. So also the difference between voice currents and generator call currents in telephoning was appreciated, and the fact that high impedance magnets were opaque to the former, but not to the latter.

In view of prior development of this art evidenced by the devices to which detailed reference has been made, and the definite prior knowldge of the electrical profession of the principles of bridging, multiple construction and the use of magnets of high impedance and self-induction for signaling purposes, and to prevent the shunt and loss of voice currents, we are of the opinion that the combination shown in Carty's patent contains no patentable novelty. Such conclusion is not at variance with the opinion in the Milheim case or of the Circuit Court of Appeals. Those cases were rightfully decided on the facts before the courts, but the actual state of the art was not then called to the court's attention; it was then found that every element of Carty's device was in itself considered old. The novelty lay in their combination, for it was not shown any such combination had been made before.

We now find that there were in existence in the clearing-out drops and the signaling apparatus of the long-distance lines, such application of the principles on which Carty's combination rests; that their application to party lines was but the natural, and to be expected advance in the progressive art to which they appertained.

Each forward step prepares the way for another, and to burden a great industry with a monopoly to each improver for every step thus

made, except where marked by an advance greater than mere engineering skill, is unjust in principle and hostile to progress.

Judge Acheson, in a brief opinion, says: "The final hearing of this case took place in Pittsburg, and at my request Judge Buffington sat with me and has prepared the opinion of the court, which I file herewith. I fully concur in the views Judge Buffington has expressed, and, accordingly, a decree will be entered dismissing the complaint."

Independent Telephony in Wisconsin.

Probably very few persons, not only throughout the country generally, but in Wisconsin, outside of those directly interested have any adequate realization of the independent telephone movement in Wisconsin. This movement started six or seven years ago in the smaller towns and among the farmers, with a demand for cheap telephones and plenty of them, and now the records show that there are about 200 independent companies operating exchanges and toll lines in the State. To give an illustration of the way in which these companies have grown, take the counties of Rock, Green, Walworth and Jefferson. Two and a half years ago there was not a single independent telephone in use within their borders. In those counties there are now 4000 of them. With this in mind, it is not so surprising to learn that there are over 20,000 independent telephone subscribers in the State, and 500 miles of farmers' lines and toll lines connecting various cities, villages and towns. A map of these lines shows a veritable network over most of the State.

The counties of Sheboygan, Manitowoc, Rock, Green, Dane, Walworth, Columbia, Marquette, Iowa, Sauk, Richland, Grant, Crawford, Vernon, La Crosse, Monroe, Juneau, Pierce, Wood and Waupaca are especially spider-webbed with lines, while Waukesha, Racine and Kenosha counties show as yet an almost unoccupied field.

Leaving out scores of small exchanges with less than a hundred subscribers, there are about 50 cities in the State which have exchanges of over 100 telephones, and the following is nearly a complete list, with the number of telephones in use: Madison, 1350; Appleton, 1200; Superior, 812; La Crosse, 860; Racine, 800; Jamesville, 785; Sheboygan, 700; Richland Center, 650; Fond du Lac, 500; Wausau, 480; Beloit, 475; Baraboo, 400; Portage, 355; Viroqua, 320; Monroe, 340; Grand Rapids, 305; Rhinelander, 300; Elkhorn-Delevan, 300; Merrill, 295; Hancock, 210; Broadhead, 200; Manston, 200; Evansville, 200; Reedsburg, 200; Clinton, 197; St. Croix Falls, 195; Sparta, 190; Edgerton, 180; Pardeeville, 175; Fort Atkinson, 174; Marshfield, 170; Neillsville, 165; Tomah, 140; Platteville, 136; Prairie du Chien, 130; Lancaster, 125; Barron, 125; East Troy, 120; New Richmond, 120; Ripon, 120; Sauk City, 102; Plymouth, 100; Millin, 100.

The Badger State Long Distance Company, operating toll lines south, each and west from Madison, now connects 40 or more cities and villages, besides many farmers' lines, and furnishes connections with 5000 urban and rural telephones, and by this spring when its lines are completed to Racine and to Rockford, Ill., it will have 7000 telephones at its service. New exchanges are already projected at Ashland, Oshkosh, Green Bay and several other places.

Power Plant for the St. Louis Exposition.

Advices from St. Louis, Mo., state that contracts for the construction of the power plant of the Exposition of 1903 have been made to the Westinghouse Electric & Manufacturing Company. Guido Pantaleoni, resident representative of the company, who negotiated the contract, says that the plant will cost $1,000,000. It will consist of 10,667 hp. The Citizens' Electric Light & Power Company, of St. Louis, has contracted with the Exposition management to furnish one-half of the total horse-power for the fair at a cost of between $400,000 and $500,000. The Westinghouse Company will supply the other half of the required power from the World's Fair plant on the site.

Machinery Hall will contain the plant, which will supply the incandescent lamps and 2000 arc lamps on the grounds. The amount in cash paid by the Exposition Company to the Westinghouse Company on the contract will be $390,000. The machinery to be installed will be redeemed by the Westinghouse people after the fair in partial payment of the expenditure of $1,000,000.

Mr. Pantaleoni states that the total horse-power which the World's Fair will use is 25,000. The first of the machinery will arrive on the site Dec. 1, 1902. Between that date and March 1, 1903, when the equipment will be installed, the plant will be thoroughly tested and turned over to the Exposition Company.

The award is for the plant complete and installed, including boilers, engines, generators, foundations, piping, cooling towers, smoke-consuming devices, short stacks for mechanical draft and other equipment. The plant is to be an exhibit, and will be situated in Machinery Hall, the most southwesterly of the group of big exhibit buildings. The boilers are to be located in a separate building 100 ft north of Machinery Hall. This building will come close under the fence at the western limits of the site near Skinker Road, and will thus be out of observation.

A tunnel is to lead the steam pipes from the boiler house to the engines. The main smoke flue of the boiler house is to be in the shape of a tunnel passing under the floor of the house and leading to the stacks. The engines to be used are vertical compound condensing.

Electric Traction in England.

Addressing the annual convention of the Tramways & Light Railways Association the chairman, Sir C. Rivers Wilson, stated that at present it was impossible to get many electric traction projects considered on their merits. If they were promoted in Parliament by private bill, or under the tramways act, they were liable to be blocked by the veto of the local authorities. If they were promoted under the light railways act the opposition of any railway company was practically fatal, and the opposition of the local authorities made the project hopeless. They had hopes from the establishment of the Light Railways Commission that greater facilities would be given in promoting this form of enterprise.

Electrical traction had made considerable progress in spite of all the obstacles it had had to encounter in 1901. When Mr. Atherly-Jones addressed them last year he mentioned that there was at that time 1200 miles of tramway in operation, but that comprised horse and steam as well as electrical traction. The latest figures given for electrical traction alone were 777 miles actually constructed, 533 under construction, and 927 authorized and about to be constructed, making a total of 2237 miles. They were a long way from the figures of their American and Continental friends, but they would observe that progress had been made, and he thought public opinion was gradually awakening to the beneficial results to be obtained from this species of enterprise. The cars running at the end of 1901 were 5844, and he understood that there were on order at the present time 777. During the present year an event of considerable interest was to take place. A meeting of the Union International de Tramways was, at the invitation of the association, to be held in London between July 1 and 4, and in connection with the meeting there would be an international tramways and light railways exhibition.

In this connection it may be noted that the construction of 133 miles of electrical tramways in South Lancashire, connecting Manchester, Liverpool, Wigan, Warrington, Leigh, St. Helens, Bolton and surrounding districts, is being rapidly pushed forward, considerable progress having been made in several lengths. Contracts have been entered into for lines from Haydock, Brough, Ashton and Hindley, from Hindley to Hindley Green, Atherton to Bolton, Atherton to Tyldesley, and Atherton to Leigh and the boundary of Lowton. The contracts for the whole of the permanent way of these tramways, necessary buildings, plant, rolling stock and complete equipment of generating station have been let for $1,750,000 (£350,414).

Brooklyn Wires.

Commissioner Dougherty, of Water Supply, Gas and Electricity, of New York City, has decided to urge before the Board of Estimate an appropriation for putting the Fire and Police departments' wires in Brooklyn under ground. The cost will be $10,000 for each department. He will also urge that the poles in use at present for carrying these wires be painted and kept in as sightly a condition as possible hereafter. The cost of this is estimated at $2,000 for the Fire Department and $500 for the Police Department. The name of Louis F. Burchard has been recommended by several persons for deputy commissioner in the Borough of Brooklyn.

CURRENT NEWS AND NOTES.

ADOPTING MARCONI SYSTEM.—The International Navigation Company will, it is understood, establish the Marconi system of wireless telegraphy on its steamers.

PERSIAN GULF TELEGRAPHS.—It is stated that England proposes to obtain permission from Turkey to erect a telegraph line from Koweit to Fao, on the Persian Gulf. Koweit is the proposed terminus of the Bagdad Railway opening up that section of Persia and the Gulf.

THE TELEGRAPH IN COREA.—The news has reached Tacoma by steamer that the Russian Minister at Seoul, Corea, has been granted the concession to construct a telegraph line from Seoul to Kyong, whence it will be extended to Vladiostock. This will give direct telegraphic communication between Corea, Russia and Nagasaki, Japan.

TRANSFORMER PATENT DECISION.—The United States Circuit Court of Appeals of New York, in an opinion written by Judge Lacombe, has confirmed the decision of the District Court, which declared valid certain claims of the Stanley transformer patent of March 1, 1892. The claims at issue were 1 and 3, which are fundamental in their scope. The parties to the litigation were the Westinghouse Electric & Manufacturing Company and the Saranac Lake Electric Light Company.

TELEPHONY IN PARIS.—A well informed Paris correspondent writes: "You published an item recently about the reduction of the telephone rate in Paris to 300 francs per annum ($60). But the reduction has not yet materialized, and there is no sign of its coming to pass. Paris is probably the cheapest big city in the world to telephone, but the management is not very vigorous. There are too many people with a finger in the pie. Of course, what they ought to do is to introduce message rates and put up the price for the big users, bringing it down for the small ones."

CURE FOR CONSUMPTION.—A cable dispatch from London of January 22 says: Dr. Symes-Thomson, consulting physician at the Hospital for Consumption, Brompton, in a lecture delivered here, spoke hopefully of the experiments which are being carried on at the hospital in the treatment of phthisis by means of Tesla's high-frequency currents and the injection into the veins of a chemical substance that is fatal to the bacilli. He quoted statistics showing that the deaths from tubercular maladies in London had decreased 55 per cent in 40 years, and predicted that such diseases would be extinct within a century.

RUSSIAN INDUSTRIES.—The disastrous effects upon Russian industries of the existing financial and commercial crisis in that country are shown in the depreciation of the share values of the French and Belgian companies, concerning which some official data have been published. On Oct. 15, 1899, the Stock Exchange value of the shares of 98 Franco-Belgian companies was 1,316,332,000 francs; on Oct. 15, this year, it had fallen to 536,292,000 francs, a depreciation of 59 per cent. The glass manufacturers suffered very heavily; the value of the total foundation capital of six such concerns falling from 17,987,000 to 3,632,000 francs. The gas and electrical companies' shares have fallen in value from 36,820,000 to 13,140,000 francs, a depreciation of 61 per cent.

FIRE IN PARIS UNDERGROUND.—As bearing upon Mr. G. Westinghouse's recent advocacy of incombustible electric cars, the following cable dispatch from Paris of Jan. 25 says: Many Parisians were seized with fright when they saw on Wednesday last thick smoke pouring from the Metropolitan Underground road at the stations of Marbœuf and the Alma. A motor of one of the trains had taken fire, and the flames were spreading with great rapidity. The train proceeded to the Champs Elysees, where the conductor requested everybody to get out as rapidly as possible. No one was hurt, but the cars were all completely burned up. All who assisted in the extinction of the fire were nearly asphyxiated, and long after the running of trains was resumed a thick smoke pervaded the tunnel and inconvenienced the passengers.

"EDISON COLLEGE GRADUATES" is the rather striking title of an article in the *New York Sun,* based on the idea that association with Edison is a training of the best kind in itself, regardless of other education. It describes in a personal way the following men who have "graduated" from the Edison Laboratory, as from a college: Nikola Tesla, Charles Batchelor, F. J. Sprague, Samuel Insull, S. Bergmann, A. E. Kennelly, E. H. Johnson, John Kruesi, T. C. Martin, S. S Wheeler, H. W. Leonard, P. Seubel, R. N. Dyer, F. McGowan, L. Stieringer, W. K. L. Dickson, A. Weber, E. G. Acheson. The list is, however, very far from complete, and should include also such well-known men as F. R. Upton, W. J. Hammer, R. Fessenden, C. J. Reed, R. T. Lozier, J. W. Lieb, W. S. Barstow, and many others, who were either actually employed by Mr. Edison or have carried out under his personal guidance and instructions some of his earliest ideas. The "Edison men" ought to get together some day and celebrate the "old man," as they all call him with affectionate irreverence.

PARIS FRANCHISES.—It is stated in a London newspaper that the Paris municipality is not getting on very smoothly with the monopoly companies who pay it for their privileges. The omnibus company is about to apply for the canceling of its agreement, on the ground that the Metropolitan Railway is a breach of contract and seriously reduces its traffic. The gas company has also for some time had friction with the municipality, the latter demanding a reduced tariff both for the public lamps and for private consumers. The Socialist Councillors advocate the "municipalization" of gas, but a committee of engineers consulted by the Prefect has reported against this idea, on the grounds that a new set of gasometers and pipes would cost 250,000,000 francs, that the experiment of municipal electric lighting in the Halles quarter has not been a success, and that Parliamentary sanction would not easily be obtained. Another project is to farm out the gas supply to a new company for a share in the profits. This is about to be discussed by the municipality.

IMPROVEMENT IN THE METALLURGY OF ALUMINUM.—The hydrate of aluminum, like most colloidal precipitates, retains with great tenacity considerable quantities of the precipitant and also of the radical with which it was before combined—a most unfortunate circumstance from a metallurgical point of view, for as the hydrate is separated by the reaction of carbonic acid gas on sodium aluminate, very appreciable percentages of sodium carbonate, amounting in some cases to 7 per cent, are held by the precipitate, and passing into the electrolytic cell, are decomposed, resulting in the contamination of the aluminum with more than mere traces of the alkali metal. Mr. H. W. Jordan, of Syracuse, observes that the amount of salt so retained, is governed largely by the temperature of the reacting gas, and that by superheating the carbonic acid to a temperature above the normal boiling point of the aluminate solution, and preferably to 400 degs. F., the quantity of carbonate held by the hydrate can be reduced below one-half of one per cent. Mr. Jordan's patent, issued Jan. 21, has passed by assignment to the Pittsburg Reduction Company, the sole American producers of the metal.

A MEDIEVAL BISHOP.—At the annual dinner of the Manufacturers' Association of New York Bishop Frederick Burgess, the newly chosen Episcopal head of the diocese of Long Island, said in part: "It is the duty of the preacher to sometimes look on the dark side of an industrial age with its multiplicity of inventions. These inventions are threatening our domestic life, and are endangering the sancity of the home. They are threatening the welfare of our women. There are 6,000,000 women wage-earners in America, and 60 per cent of our workingmen could not support their families unless their women also went out to work. To find their places as breadwinners the women have to go out of their own homes, out of the protection of their brothers and fathers. We meet them in the trolleys and in the street, and they push and jostle as hard as the men. Their modesty is being rubbed off and there is a lessening of the chivalry of men. Industry, inventions and billion-dollar companies are not all. If this world is not to become a pitiless struggle, crushing out the family life, men must take on some of the tenderness of women and the chivalry of man must be preserved."

SPANISH SYSTEM OF WIRELESS TELEGRAPHY.—Colonel Cervera, of the Spanish Army, has, according to a Madrid dispatch, invented and developed a system of wireless telegraphy, which is now working successfully between Tarifa and Ceuta.

NEW YORK CENTRAL TUNNEL.—In his evidence before the coroner as to the recent accident in the terminal tunnel, Chief Engineer Wilgus, of the New York Centrals, says that the underground terminal will be about 18 ft. below the surface and connections will be made with the Rapid Transit tunnel. It is expected that the work will be done inside of two years. Mr. Wilgus considers that it is impossible to improve upon the present signal system in the tunnel.

TRANSMISSION AND THE GREAT LAKES.—A Cleveland correspondent states that the vessel owners on the Great Lakes are viewing with suspicion the rapid extension of water power utilization for electric transmission purposes. At the recent annual meeting of the Lake Carriers' Association the report of the secretary pointed out the tendency to utilize for this purpose all waterfalls in the connecting waterways of the Great Lakes, and unless the Government authorities and vessel interests are on the alert they will find that the interests of navigation will be injuriously affected thereby. Considering all the water has got to flow ultimately into the lakes, "we don't see why."

COPPER OXIDE DRY CELL.—A patent granted Jan. 21 to Albert De Dion and Georges Bouton, of Puteaux, France, describes a dry cell, the two elements of which are oxide of copper and zinc. Oxide of copper is compressed in the form of a cylinder, and has embedded in the middle a cylindrical strip of copper which forms the positive electrode. The containing vessel is of zinc and the exciting fluid is caustic potash or soda. The battery may be hermetically sealed and presents, it is claimed, the important advantage that it can be regenerated by the electric current when the battery is exhausted —that is, when the oxid of copper is reduced and potassium zincate is formed, the passage of an electric current causing the oxygen released by it to combine with the copper, the potash being set free.

TROLLEYS FOR CHINA.—It is announced that steps are being taken in this city for the organization of a corporation, constituted of some of the most influential street railroad interests of New York, to make a bid for the contract to build, equip and operate a system of electric street railroads in the city of Shanghai, China. Tenders for this purpose must be made to the Shanghai Municipal Council by March 7, unless a postponement is granted. An effort to give such bids was made two years ago, but was subsequently frustrated. The present plan is stated to be upon a more stable basis. J. R. Patterson, of Fearon, Daniel & Co., is engineering the plan to make an American bid for the road. The new road is to be 23 miles in length, and of standard gauge. It is intended that the operation shall be done by natives. An English company has already been organized to bid for the plan. The amount involved will be about $5,000,000.

GOVERNMENT PACIFIC CABLE.—At Washington on Jan. 28, by a vote of 8 to 7, the House Committee on Commerce decided in favor of Government construction, operation and maintenance of a Pacific cable, and ordered a favorable report on Representative Corliss' (Rep., Mich.) bill, providing the details of the undertaking. As finally determined upon, the measure provides for a Government cable from the coast of California to Hawaii and the Philippine Islands, via Midway and the Island of Guam, or by whatever route the President may consider most practicable. The maximum cost is fixed at $10,000,000, of which $500,000 is made immediately available. The work of construction is intrusted to the War and Navy departments, and after the cable is laid its operation is to be under the control of the Postmaster General, Secretary of War and Secretary of the Navy.

INDEPENDENT TELEPHONY WEST.—Telephone manufacturers, supply men and other kindred interests announce that a banquet will be tendered in Chicago to exchange representatives from Illinois and adjoining States on April 9 or 10. At that time the Illinois Independent Telephone Association will also convene in Chicago, and as the officers of that association are on the committee for entertainment of visitors, all interests will be amply cared for. For some time the necessity of an interstate or Central States telephone association has been apparent, and a large number of exchange owners are strongly in favor of such an organization. This matter having come to the attention of the manufacturers and dealers in telephone apparatus and auxiliary supplies, they decided at a joint meeting, held at the Palmer House, Chicago, Jan. 16, that on the occasion of this gathering they would provide entertainment for the visitors during their stay in Chicago. For full information, date of banquet and other particulars, an invitation which will be mailed direct to delegates and representatives, will give the points, and due announcement will be made in the electrical press.

THE WATER POWERS OF IRELAND.—The measure introduced in Parliament a couple of seasons ago by T. M. Healy to make possible the utilization of the vast and wasted water power of Ireland will be brought up again at this session. The measure, though a most admirable one in every respect, was for some reason opposed by the landlord interest, and it accordingly received its quietus in the House of Lords. Interest in it is revived by a plan now being discussed in France for the exploitation of the resources of the Pyrenees. The mineral wealth of these mountains, particularly in zinc, aluminum and iron, has been esteemed highly since 1874. The problem has been to work them at a profit, owing to the difficulties of transport, on the one hand, and the absence, on the other, of coal to smelt the ores on the spot. The idea now is to use for this latter purpose the water power of the mountain torrents. It is claimed that in the adoption of a plan of this sort lies the industrial regeneration of France and Ireland. It is computed that the wasted water power of the Pyrenees is equal to the whole of the steam power employed in all the factories of Europe. In Ireland the conditions are similar. That large tracts of territory in Ireland contain mineral wealth of various kinds is undeniable, and if some such measure as the Healy bill became law a long stride would have been taken toward the industrial regeneration of the country.

MANUFACTURE OF ELECTRICAL CONDENSERS.—Two patents were issued Jan. 21 on the manufacture of electrical condensers, one to Professor Elihu Thomson and the other to Jesse Coates. The Thomson patent relates to a method of impregnation or insulation. A number of condensers are arranged in a bunch lightly pressed together, and then thoroughly baked for a number of hours in a hot oven. They are then placed in the bottom of a treating tank having an air-tight cover, which is connected to an air pump and exhausted, the interior of the tank being heated by steam coils. After the pumping has continued about ten hours, insulating material is caused to flow in the bottom of the treating tank, its level being allowed to rise so as to cover an inch or more of the bottom portion of the condensers. Steam is circulated through the heating coils, and the insulating fluid being thus in a highly fluid condition and in a fairly complete vacuum, is readily absorbed by the porous substance of the condensers into which it is drawn by the action of capillary attraction. As the fluid gradually creeps up through the condensers it pushes before it whatever bubbles of air or collections of gas may remain until, when the entire insulating substance of the condensers has become saturated, the last trace of the gas and vapor has been removed. After the condensers have thus become saturated, the level of the insulating fluid in the treating tank is allowed to rise until the condensers become wholly submerged, after which the pumping may be discontinued. The condensers are now allowed to cool, a cooling liquid being admitted to the pipes for this purpose. To prevent the occurrence of cracks as the insulating material solidifies, mechanical pressure is applied by screws through the sides of the treating tanks. The insulating fluid near the top of the tank may be maintained fluid, while that below is cooling, this being done by passing steam through only one or two of the steam pipes at the top of the tank. The Coates patent employes an apparatus very similar to that of the Thomson patent, but provision is made whereby the condenser elements are cooled from the interior of the mass instead of from the exterior. In arranging the condensers for treatment, each condenser is placed between two thin sheets of metal and then a number of condensers are arranged side by side in a frame in such a manner that they may be acted upon by cooling devices so arranged as to abstract heat from the interior of the mass of condensers as assembled. Cooling boxes are located for this purpose between the pairs of condensers, into which cooling water is admitted after the insulating material has been thoroughly saturated in the manner described in the Thomson patent.

LIGHTING ST. PAUL'S CATHEDRAL.—A cable message from London of Jan. 18 says: In addition to providing electric lights for St. Paul's Cathedral, J. Pierpont Morgan has added to his original gift, making the total over £10,000. It is expected that the new lights will be very soon in use in the choir.

SYSTEM POWER IN TUNNELS.—Assemblyman Wainwright has introduced a bill prohibiting any railroad corporation operating any road by steam power in any tunnel in the Borough of Manhattan. Violation is made a misdemeanor, and upon conviction, the corporation is punishable by $500 fine for each offence.

RAILROAD TELEPHONY.—The Illinois Central Railroad will have all its principal stations equipped with telephone. The installation will cost about $100 per mile or approximately $540,000 for the entire road. Chicago will probably be the starting place. Almost simultaneously work will be commenced at New Orleans and St. Louis. From these centers a two-wire line will be extended to the principal points until every station in the entire system is included.

TELEGRAPH CODE FOR AFRICA.—The United States State Department has received a telegram from the manager of the Western Union Telegraph Company, at Washington, to the effect that the "unicode" has been deposited by the British Government at Aden and Cape Town, and may be used in addition to the codes already notified for messages to and from Cape Colony, Natal, Rhodesia, Seychelles, Mauritius, Madagascar, British and German East Africa, Mozambique and Lourenco Marquez.

BRANLY AND LODGE.—According to a cablegram to the *New York Herald*, M. Henri Poincare, the eminent mathematician, has called upon Professor Oliver Lodge to confirm publicly his private acknowledgment of Professor Branly's priority in the discovery of the filings coherer. Professor Branly has received a prize from the French Academy of Sciences for the discovery, which he announced to the world in 1891. The claims made for Dr. Lodge appear to date no earlier than 1893.

WIRELESS TELEGRAPHY BETWEEN TRAINS.—A Jamestown, N. Y., dispatch states that Captain F. P. Cobham, of that place, has invented a system of wireless signaling between railway trains which, it is stated, has worked satisfactorily in tests. The instruments, which are placed on the locomotive, give notice when the engine is within 2000 ft. of another engine on the same track, and at the same time indicate in which direction each locomotive is moving. If one of the locomotives is stationary the fact is also indicated.

THE CAPE-AUSTRALIA CABLE.—United States Consul General Bray reports from Melbourne, Nov. 10, 1901, that the Eastern Extension Australasia & China Telegraph Company, Limited, has notified the government of the State of Victoria that the Cape cable from Durban (Natal) to Freemantle, Western Australia, is now ready for use, and congratulatory messages have been exchanged with the governments of Cape Colony, Natal and Mauritius. The section of the cable between Freemantle and Adelaide, South Australia, is now in course of construction.

COLOGNE STREET RAILWAYS.—United States Consul Barnes reports that the Cologne Street Railway Company has been acquired by the city for $3,451,000, payable in annual installments up to June, 1913. The city has appropriated $4,204,000 to convert existing lines into electric traction and for the building of some new lines. The ordinary fares charged on the line are the equivalent of 3½ cents per passenger for the maximum distance and 2 4-10 cents for the minimum distance. Persons attending educational institutions get commutation tickets costing 1⅗ cents. Motormen receive as wages 83 cents, and conductors 71.4 cents per day of 10 hours, with one day every two weeks off.

AUTOMATIC FROST ALARM.—An automatic frost alarm is now in successful operation in a vineyard in the frost belt of California. The first instrument was invented and installed by Mr. L. L. Lewis, a vineyardist located near Sacramento. The apparatus consists of a mercurial thermometer in the shape of a horseshoe with a bulb at each extremity. A platinum wire connects with the mercury in the thermometer, and when the temperature falls a circuit is closed, causing an electric bell to ring an alarm until the atmosphere becomes warmer. The instrument is placed in a vertical position with the two bulbs uppermost. On a recent occasion the automatic apparatus sounded a timely alarm during the night, and the vineyardists turned out and began "smudging" or lighting fires between the rows of vines. By two hours of this smoking process the frosting of the vines was entirely prevented, while other vineyards in the vicinity will lose their entire first crop.

EFFECTS OF TELEPHONY.—Professor Zimmer, of Germany, has made a careful analysis of the mental conditions of women school-teachers. He has drawn his information from all the asylums in Germany, Austria, Switzerland and Russia, and found that in every 85 female patients there is one school-teacher. In Prussia there is one teacher to every 350 women of the population. It seems to follow, therefore, that mental disorders among teachers are four times as numerous there as they ought to be. He says: "If telephone girls or salesgirls show signs of mental disturbance it is not to be wondered at, for their occupations are hardly those a woman can call suitable to her sex, but in teaching, which is usually considered a suitable employment for women, when the results are so disastrous there is every reason for serious consideration." Professor Zimmer is sure that in other countries, notably England and the United States, where women are more widely occupied in business and in professions than in Germany, scientifically collected statistics will show the same melancholy results.

BROOKLYN TROLLEY TUNNEL.—The report of the commissioners appointed in Brooklyn to pass on the route and style of construction of the proposed Manhattan-Brooklyn Rapid Transit tunnel has been approved by the Appellate Division of the Supreme Court, Brooklyn. The commissioners, in their report, recommended the Flatbush Avenue route and the carrying out of the plans laid down by the Board of Rapid Transit Commissioners without change. The commission has secured the requisite consent of property owners along the proposed route without necessity of recourse to condemnation proceedings, so that nothing now stands in the way of advertising for bids under which the contract is to be eventually let but the completion of the work of formulating the contract itself. Letters and appeals have reached the members of the commission demanding that whatever contract be entered into there should be as a result only a 5-cent fare chargeable within all the limits of the five boroughs at any points where the routes for tunnels as laid down shall reach.

AUTOMOBILES IN BELGIUM.—Mr. George W. Roosevelt, United States Consul at Brussels, Belgium, writes: In view of the growing interest in mechanical traction, our manufacturers of automobiles, cycles, etc., may care to learn that, in the early spring two international exhibitions of automobiles, cycles, etc., are to be held in Brussels. From the 8th to the 17th of March, 1902, an International Exposition of Mechanical Locomotion will be held in the grand hall of the palace in the Park Cinquantenaire; from the 15th to the 23d of the same month, the tenth International Exhibition of New Locomotion (automobiles, cycles, sports and industries connected therewith) will be held at the Pole Nord, Brussels. In the international exposition at the Park Cinquantenaire, there is to be a section devoted to aerostatics, organized by the Aero Club of Belgium, and under the direction of the aeronaut, Mr. Capazza, who will exhibit two of his balloons, one torn and worn, accompanied by his parachute, and the other inflated. The exhibition will include every kind of known mechanical locomotion, automobile, velocipede, aerial, electric, maritime and nautical. Trials of aerial locomotion will take place in the Park Cinquantenaire during the exposition. As regards the disposition of eventual profits, the Belgian Syndical Chamber of Automobiles has decided to make the following division: Twenty per cent will be set aside as the nucleus of a fund; 30 per cent will be used in experiments, such as races, competitions, trials, etc.; and 50 per cent will be returned to exhibitors, who will thus share directly in the profits of the exposition and have the chance of regaining a part of the amount expended by them for space. In this way, constructors and agents may participate without incurring very great expense.

MONEY FOR COOPER UNION.—Announcement is made that Andrew Carnegie has given a second gift of $300,000 to Cooper Union, New York City, and that the heirs of the Peter Cooper estate —ex-Mayor Abram S. Hewitt and others, have given another $300,000. The income which will be derived, will enable Cooper Union to expand and improve itself both regarding instructors and its accommodations for students. It will enable the institution to occupy its entire building, making use of the added space for educational purposes and doing away with numbers of the stores on the ground floor, the rental of which formerly was necessary to help defray the expenses of the institution. Likewise, this additional revenue will enable suitable compensations to be paid to the teachers and instructors. Among other improvements contemplated is the enlarging of the physical laboratory so that with the incoming year there will be increased facilities for instruction in electricity.

LONG-DISTANCE TELEPHONE WORKING.—With regard to a recent discussion in our columns of long-distance telephone working, the London *Electrical Engineer* makes the following comments: In the issue of ELECTRICAL WORLD AND ENGINEER for the 7th inst., the editor puts forward an interesting scheme for relieving the long-distance telephone lines in the States of a large part of the heavy traffic with which they are burdened in the busy hours of the day. Putting it shortly, his plan seems to be to use the lines for about four hours each night for telegraphing messages, which would be delivered at their various destinations by telephone on the opening of the offices in the morning. Assuming the use of an automatic printing instrument at a working speed of 100 words a minute or thereabouts, he points out that in the case of a single line between Chicago and New York, about 500 ten-word messages per hour in each direction would be within the range of capacity of the system if such messages were directed to the respective telephone numbers of the recipients. The message slips could be filed away and telephoned to the proper addresses on the opening of business hours, the slips being sent on by post as an additional check as fast as telephoned. The whole operation would only take a few hours, and the result would be a very convenient and cheap method of sending night messages quickly, and a considerable increase in the earning capacity of every long telephone line. As opening up a new source of revenue, the editor regards the scheme as offering a capital opportunity, besides doing the public a favor which would still further increase the popularity of the telephone. Such an arrangement in this country would, of course, not be practicable, as we have no long-distance telephone lines the limits of which could not be reached almost as quickly by post, but in the States, where the conditions are vastly different, we see no reason why the scheme should not work well.

LETTERS TO THE EDITORS.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with interest the article by Dr. Roeber in your issue for Jan. 18, 1902, in which he criticises my views about the Edison nickel accumulator.

In regard to the word "aqueous tension," which I have heard in common use as an abbreviated form for "aqueous vapor tension," it is merely a matter of terms. The word "tension" alone is used in exactly this sense on page 134, Volume I., of the English translation of "Mendeleff's Principles of Chemistry." I have consulted several chemists in regard to the term, and they say without hesitation that "aqueous tension" could mean only "aqueous vapor tension." The original article was written after a hard day's work, and I suppose I used the shorter term, following the path of least resistance. Whatever ambiquity of the term "aqueous tension" there be, it certainly cannot mean "osmotic pressure." A glance at my original equation would have shown that it did not hold for "osmotic pressure," but did hold for "aqueous (vapor) tension." Had the formula been developed on the lines of the osmotic theory it would have been expressed in terms of the ionic concentrations.

With regard to the hydrogen electrode, I thought it well known that its potential changes but little with the concentration changes of the alkaline solution. For this reason it can be used in practical work where its results are properly interpreted, as a means of diagnosing the electro-chemical changes at anode or cathode. As its potential depends on the concentration of the hydrogen ions and this concentration in an alkaline solution varies but little, I thought it unnecessary to reply to this point of Dr. Roeber's.

Dr. Roeber's elaborate theories of concentration changes have been, it would seem, the result of theoretical, academic discussions. Any theoretical superstructure should be built on a firm, experimental foundation. I have made a good many measurements of the polarization of cells of the oxygen-lift type, and have found that "concentration polarization" is but slight, provided no lower stage of oxidation has been reached. The steady drop in voltage on closed circuit is due in great part to entirely different causes, i. e., changes in the electrical properties of the plates themselves.

Dr. Roeber's well-worded and well wrought out theories of concentration changes which do exist, but have but little effect on the polarization changes in alkaline solutions, are like vernal flowers, very pretty, but "have nothing to do with the case." On one point I am in perfect accord with Dr. Roeber; that is, that any matter under discussion should be decided in the light of experimental evidence, and that my views also should be placed before that court of appeal.

HARTFORD, CONN. WOOLSEY MCA. JOHNSON.

Engine Specifications.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the letter of Mr. Bertram in your issue of Jan. 11, asking for an expression of opinion as to the guarantee to be given by an engine builder covering the regulations of engines for driving alternators in parallel operation, I can say that the engines built by us for this purpose are guaranteed not to exceed a certain per cent variation in speed from no load to full load, and are also guaranteed not to exceed a certain maximum angular variation or displacement of a point on the flywheel of the engine with reference to a point on a flywheel revolving uniformly at the normal generator speed, the latter guarantee being usually stated at such a fractional or decimal part of one degree as would correspond to a displacement of 2½ degs. of phase.

As you will see, the above guarantee completely protects the buyer as far as the satisfactory operation of the engine on the score of speed and angular variation is concerned.

MILWAUKEE, WIS. EDWIN REYNOLDS,
Chief Engineer Allis-Chalmers Company.

To the Editors of Electrical World and Engineer:

Sirs.—The letter of Mr. Bertram in your issue of Jan. 11 brings to mind a case of ancient history in which the generator manufacturer desired to limit the phase displacement to 675-1000 of a degree (.675 deg.), for a unit having 106 poles at 68 r. p. m. This means for the engine 125-10,000 of a degree (.0125 deg.) variation from the mean position, which is practically impossible.

In the light of further experience all manufacturers of generators are now willing to allow 2½ degs. phase displacement, which may easily be translated to terms of angular variation by dividing by one-half the number of poles.

The most difficult possible case for engine manufacturers, under present conditions, would be the one stated above, which covers a 60-cycle generator at 68 r. p. m., the permissible angular variation from mean position of engine during a revolution being 47-1000 of a degree (.047 deg.). The engine manufacturers are willing to meet this extreme condition, and, therefore, the engine specification may be simply "The departure from uniform motion during a revolution shall not cause a phase displacement to exceed 2½ degs. either way from position of uniform motion, which, in terms of degrees of angular variation per revolution, equals $\frac{5}{\text{poles.}}$."

CHICAGO, ILL. A. D. LUNDY.

To the Editors of Electrical World and Engineer:

Sirs.—In your last issue Mr. Bertram inquires if there is a clause which can be stated in plain English and which will cover the successful parallel operation of engine-driven alternators. I believe there is no clause which covers broadly and without qualification the successful parallel operation of engine-driven alternators under any and all conditions, but clauses can be inserted in the contract which will so far protect the operating company that it can proceed with a reasonable anticipation that such difficulties as are met with can be

surmounted, provided, of course, the operating company will confine its dealings to manufacturers whose purpose it is to provide a successful installation, as distinguished from those manufacturers who consider their duties and responsibilities fully discharged when they have delivered the apparatus the contract calls for, irrespective of its strict adaptability to the purposes for which it was purchased.

There are certain difficulties connected with the disposition of circuits, and the control of auxiliary apparatus which cause more or less trouble, but which so indirectly concern the engine and dynamo units that I do not think such difficulties are properly within the scope of the engine or dynamo contract. Eliminating these external troubles, and assuming that the dynamos are properly designed, I believe that engines meeting the following requirements will give satisfactory results:

1. The engine speed from no load to full load, or within any other specified limits, should not fall off more than a specified percentage. It is possible to get close regulation with some engines and still run in parallel. Apparently this is not true of all engines.

2. The speed characteristics of engines designed to drive dynamos operating in parallel should be practically the same. In other words, the speed of all the engines should be practically the same for the same load, irrespective of what the load is. For the proper division of the load between the several dynamos, this is absolutely necessary if there is no speed changing device for changing the speed of the engines while in operation. With a speed changing device, differences in the speed characteristics can be compensated for if the load is not too variable, but even then reasonable accordance in the speed characteristics is desirable.

3. The angular deviation, by which we mean the amount a point on the flywheel varies in position during the revolution when compared with a point on a wheel running at an absolutely even speed at the average speed of the engine, should not exceed the amount specified by the dynamo manufacturer.

4. The governor should be so constructed or so controlled that, without impairing the regulation, it will not vary the admission of steam synchronously with variations in load (and, therefore, variations in speed) due to the interchange of cross-currents between two or more dynamos operating in parallel, while at the same time it is left free to vary the admission of steam to suit changes of load in the working circuits.

NEW YORK. E. A. MERRILL.

To the Editors of Electrical World and Engineer:

Sirs.—In the matter of engines for alternators the buyer does not by any means have a monopoly of the trouble. It appears to us that the engine builder has much the largest share. His bid is based upon the supposition that average conditions will be met. When the contract is awarded he often finds that he must adopt a much more expensive construction than contemplated in order to make a satisfactory engine to direct connect with the dynamo selected.

There is much variation in the requirements as to angular variation, which means large differences in flywheel weights, perhaps so great that altogether different shafts are required in two units of the same capacity and speed, simply on account of one having so much more flywheel weight than the other.

Another difference in practice is in the weight of armature and the magnetic pull due to displacement of the field. It is apparently assumed by the dynamo builders that the magnetic pull due to a displacement of the revolving element of the generator of 1-32 inch from its true position, must be provided for by the engine builder, and by inference that a greater displacement than this is at the risk of some one else.

A recent case is of an alternator of 125 kw at 240 r. p. m., in which the weight of the revolving element is 3800 lbs., and the magnetic pull due this displacement is given at 3600 lbs., making in case the displacement should be downward a total of 7400 lbs., which in a 125-kw unit is readily provided for with standard construction.

But the next job is a 90-kw alternator by the same makers, in which the revolving field weighs 5000 lbs., and the pull due to 1-32-inch displacement is 15,000 lbs., or a total of 20,000 lbs., a weight out of all proportion to the capacity of the generator, and so great that to design a shaft and bearings to carry it at the speed (270 r. p. m.) is not by any means a simple problem.

The consequence is that the engine for the 90-kw unit is a heavier and more expensive machine than the one for the 125-kw machine. As the only way we can see out of these difficulties we have adopted the practice of submitting prices for engines for direct connection to alternators only upon receipt of full data regarding these points. We enclose you copy of the questions to which we request replies in such cases.

ERIE, PA. E. J. ARMSTRONG,
Superintendent Ball Engine Company.

[Following is a copy of the enclosure referred to: In the case of engines direct connected to alternators, intended for parallel operation, it is necessary to have the following data: 1. The number of poles or the frequency. 2. The maximum angular variation. This should be stated clearly and should specify whether the total variation or the variation either side of the mean is meant. 3. Magnetic pull by displacement of shaft. 4. Weight of revolving field. 5. Radius of gyration of revolving field. The last two items are necessary in order to correctly figure the flywheel weight needed. The third and fourth affect the shaft diameter. And all are essential to figure cost of engine intelligently. Engines operating in parallel should not have a speed regulation closer than 4 per cent. Synchronizing devices will be furnished, if desired, at an extra price.]

Properties of Collector Rings.

To the Editors of Electrical World and Engineer:

Sirs.—I wish to thank you for having kept your readers informed of the various discussions which have been going on lately in the European electrical papers relating to the new properties of ring collectors or commutators, and which were pointed out by me in patent specification relating to self-excited, series, shunt and compound-wound alternators, now filed in the United States Patent Office. This new property consists in the absence of the ordinary effects of self-induction in the windings of, for example, the armature of a bipolar dynamo, when the latter is connected to a polyphase circuit of, say, p phases, by p brushes resting on the commutator, the angular distance between the brushes being $\frac{360}{p}$ and driven at the speed of synchronism, the direction of rotation being that of the revolving field produced by the polyphase currents sent into the windings through the p brushes.

This property, which had never before been pointed out, was not *a priori* evident. It is true that the coils of an armature, at whatever speed the latter be driven, give passage to currents which are essentially variable, and as a consequence it was thought that we would find between any two brushes the counter-electromotive force of self-induction developed in the group of sections in series between these two brushes and induced by the instantaneous variation $\frac{di}{dt}$ of the current i which traverses these sections. This was the opinion put forward by M. Leblanc.

I have shown if there be always a tendency to produce a counter electromotive force of self-induction, it may, however, be counterbalanced at or in the neighborhood of synchronism by the electromotive force due to mutual induction between, on the one hand, the sections in short circuit under the brushes in which the rapid variation of current were taking place during commutation; and, on the other hand, the sections in circuit. I have furthermore shown that, leaving aside the question of harmonics, the commutation at synchronysm is perfectly satisfactory.

Up to the present time the published discussions have only related to polyphase currents. I take this occasion to call to the attention of those of your readers who have followed this discussion that it is possible to impress the effects of self-induction even in those cases where single-phase current only is introduced into the armarture by two brushes set at an angle of 180 degs. To do this, it is only necessary to add to the armature a polyphase short circuit winding—a squirrel cage winding, for example. The alternating flux produced along the line of the brushes ($\phi\, max.\ sin\ wt$) can be considered at any instant as the resultant of two revolving fluxes, $\frac{\phi\ max.}{2}$ turning, in the opposite sense one with respect to the other. If the armature is driven at synchronous speed in one direction or the other, one of the fluxes, $\frac{\phi\ max}{2}$ which turns in the same sense as the armature will continue to exist, while the other turning in the opposite sense with a speed $2w$ with respect to the armature, is neutralized by the

polyphase short circuits, and we have the same effect as if we were dealing with a polyphase instead of a single phase circuit. This is the well known property of magnetic screens.

The commutation is evidently made better in the same measure as the effects of self-induction have been neutralized by the polyphase short circuits. If in a case where we are dealing with polyphase currents, we introduce this second short circuited polyphase winding on the armature, these latter can only be of secondary importance, and do not change in any way the nature of the phenomena; but in case we make use of single phase currents, their presence is necessary for the production of the same effects.

I trust that this explanation will suffice in the minds of your readers to terminate discussion on a question which has given rise to much confusion, and to which I would not now allude if publications in your pages had not opened this question.

SEVRES, FRANCE. MARIUS LATOUR.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Single Phase Synchronous Motor Without Excitation.—BOUCHEROT.—Hospitalier's ondograph, in its most recent form, contains a small synchronous single-phase alternating current without any winding which is supplied with direct current. This is the simplest type of motor, as it consists only of a movable aggregate of iron sheets, which turns between the projecting parts of another fixed aggregate of iron sheets, which is provided with the winding in which the alternating current flows. He illustrates the motor and gives some calculations regarding it; he believes such motors are very suitable for laboratories whenever one wants to produce synchronous movements without complications.—***L'Ind. Elec.*, Dec. 10.**

REFERENCES.

Synchronous Converters.—BLONDEL.—A second mathematical paper on the graphical theory of the regulation of synchronous converters. This paper deals with the determination of the excitation of the converter, but is too mathematical to be abstracted. The synchronous motor diagrams may easily be applied to the study of the converter and enable the analysis of the conditions of its operation to be made in the most varied cases. This method enables one not only to prophecy qualitatively the phenomena, but also to calculate them numerically by combining the characteristic curves with the experimental data.—*L'Eclairage Elec.*, Nov. 23.

Uniformity of Speed of Steam Engines and Operation of Alternators in Parallel.—As has been noticed before in the Digest, a section of the Internat. Soc. of Elec. in Paris has been discussing this problem at length. This issue gives a complete account of the following papers, abstracts of which have been noticed before in the Digest: An exposition by Leblanc of the program of the committee; a paper by David on a method of measuring by experiment the degree of uniformity of speed during one revolution of a steam engine; a paper by Cornu on an optical method for determining the law of the periodic variation in the speed of a revolving engine; a paper by Boucherot, on definitions, analysis of diagrams, oscillations and mechanical resonance. Several tables and 30 plates of diagrams which belong to these papers are given in a separate number.—*Bull. de la Soc. Int. des Elec.*, Nov.—An illustrated account of the discussion of these papers, by Rateau, Cornu, Boucherot, Dubois, David, Perrin, Hospitalier, Arnoux, and Saletter, Harle & Co., in *Bull. de la Soc. Int. des Elec.*, Dec.

Alternating Current Motor.—FISCHER-HINNEN.—A brief illustrated description of tests made with a self-starting single-phase motor without brushes, of the type recently described by him.—*L'Eclairage Elec.*, Dec. 21.

Core Transformers with Maximum Efficiency.—PUNGA.—A long article, illustrated by diagrams, giving the mathematical theory of the design of core transformers so that the efficiency becomes a maximum.—*Zeit. f. Eelk.*, Dec. 15, 22.

Large Alternators.—ROTHERT.—A very long article on the design of large alternators. Tables are given, showing in detail the data of the design of 23 different alternators of different makes which had been exhibited at Paris. These data are then carefully analyzed.—*L'Eclairage Elec.*, Nov. 30, Dec. 7.

Alternators at the Paris Exposition.—GUILBERT.—A long article in which he gives a critical summary of the principal and general features of the alternators exhibited at the Paris exposition.—*L'Eclairage Elec.*, Nov. 23, Dec. 7.

Switches for Shunt Motors.—KRAUSE.—An illustrated description of a device for sparkless disconnection of shunt motors. He shows how the same device may also be used for reversing switches.—*Elek. Zeit.*, Dec. 26.

LIGHTS AND LIGHTING.

Arc Lamps.—BLONDEL.—A brief note criticizing some special points in a paper of Laporte and Leonard on arc lamps, recently abstracted in the Digest; he discusses especially the cause of discrepancies between this and his own measurements. He adds a brief remark about Laporte's paper on the Bremer arc lamp. He calls attention to the fact that the relative efficiency of the Bremer arc lamp compared with the Brille lamp, differs greatly, whether it is used with or without a globe, while the addition of the globe should cause the same reduction in both lamps. Without globe the consumption of energy per spherical candle in the Bremer lamp is half that in the Brille lamp; with globe, it is more than 60 per cent. He explains this by saying that while the addition of a globe apparently modifies the economy of the Bremer lamp, it is simply because the presence of the globe makes the distribution of its light more uniform; the measurements having been made in a plane perpendicular to the plane of the carbons, i. e., in the most favorable plane. The addition of the globe simply corrects and exaggerates the cause of the superiority of the Bremer lamp. A fault of this lamp is the instability of the light. The rapidity of the consumption of the carbons in this lamp is interesting because it confirms the general rule that in arc lamps, any gain of illumination is accompanied by a reduction of life.—*Bull. de la Soc. Int. des Elec.*, Nov.

Alternating Current Incandescent Lamps.—LEONARD and JANET.—A paper, giving an account of an investigation of the variations of the luminous intensity in one period, of the incandescent lamps supplied with alternating currents. The method used is described and results are given of tests regarding the variations of the luminous intensity during one period (which for a 110-volt lamp with 42 periods, was 16 per cent total variation in parts of average luminous intensity); influence of the frequency upon the variations; influence of the mass of the filament upon the variations; influence of the waveform of the e. m. f. of supply upon the absolute variation of the luminous intensity; variation of the power and of the calorific capacity during one period. The results are given in diagrams and tables.—*Bull. de la Soc. Int. des Elec.*, Dec.

POWER.

Power Transmission Plant in New Zealand.—HAES.—An abstract of a paper read before the Elec. Assoc. of New South Wales. The town of Rotorua in New Zealand is a favorite resort of tourists and sick people. When the institution of a modern system of drainage and sewerage was undertaken an electric power transmission was adopted. The single-phase alternating current system is used in conjunction with water-power. There are two turbine-driven, 50-kw alternators of the inductor type, the voltage being between 3200 and 4200. The line is 13 miles long. The sewerage pumps are driven by induction motors. Current is also supplied for lighting.—*Lond. Elec.*, Dec. 27.

Electricity in a Mine.—BEUTOM.—An illustrated article on the electric installation of mines, near Halle, Germany. For the generation of the electrical energy, gas engines are used, gas being utilized which otherwise would be wasted. The gases come from a distilla-

tion of coal-tar for the production of paraffin. There are two gas engines, each driving an 80-kw, 3000-volt alternator. The transmission line is 2.2 kilometers long. At the receiving station the voltage is reduced to 120 for lighting and 500 for power purposes. Descriptions are given of an electric winch and a centrifugal ventilator.—*L'Eclairage Elec.*, Dec. 21.

TRACTION.

Hamburg.—VELLGUTH.—An extended and fully illustrated article on the street railway system of Hamburg and Altona, Germany. In 1886 at the request of the municipality, some extensive experiments with storage battery cars were made which proved complete failures, fortunately for the railway interests of Germany, as if these experiments had proved successful the different cities might have required the introduction of storage battery cars on other roads. In 1894, the first trolley line was put in operation by the company, and in 1897 the electrification of the entire system was practically completed. The company owns 138.83 kilometers of track, most of which is double track, and adding switching, depot and other tracks, the total would be 260 kilometers. Under the franchises all of the tracks and buildings within the city limits of Hamburg lapse to the city in 1922. The company also pays the city 0.25 cent for every passenger carried, which amounts to about 9 per cent of the gross receipts. It also pays to the city 5 per cent of all the money received for season tickets, and a certain percentage of its surplus after the payment to the stockholders of a 6 per cent dividend. The track construction is very heavy, and rails weighing 53 kg. per meter are used throughout. The trolley system is used throughout. The trolley wire used in the suburbs is 8.3 mm. in diameter, while that within the city limits is a wire with a cross section of 80 square mm. Recently a wire having a rectangular shape but rounded at the four corners has been introduced. The area of this wire is 90 square mm. Experience has shown that it is a simple matter to stretch this wire. Current is purchased from the local electric light and power station. At the several feeding points where the current passes into the trolley wires, the tramway company and the electrical company both have wattmeters, by which the power taken is measured. There are 33 of these points and 800 amperes is the maximum current fed at any of these points. No feeding point is selected where there is less than 500 amperes to be fed into the circuit. The company uses controllers with six operating and six braking steps. The short circuit and magnetic brake operated by the controller, are employed simultaneously with the hand brake for operating purposes, but the motorman has instructions to use the last braking point which furnishes the current direct from the trolley wire only in cases of emergency, and the controller is fitted with a register which shows how many times this emergency stop is used. The motor pinion is of cast steel and the gear of gray iron. These materials have been selected, as it is found that the life of each is about the same, and the company believes in installing a new gear and a new pinion whenever one has worn out.—*St. R'y Jour.*, Jan. 4, and Internat. Ed., Jan.

Rail Feeder Construction in San Francisco.—FOSTER.—An illustrated description of the methods used for improving the rail return on his system. As originally built, the rails were connected by fish-plates and bonded by three bonds of 85 square mm. As the load of the system increased, the return became inadequate and the company decided to increase the capacity of the return circuit. For this purpose a number of old horse-car rails bonded by iron rivets were buried in the ground to connect the negative bus-bar with the track and the joint was made by surrounding it by a copper tube. It was immersed in water for four months, at the end of which time the joints showed 17 per cent more conductivity than an equal length of rail, or a loss of only 5 per cent over its original conductivity. The soil in which the rails were laid was clay, which was practically neutral chemically. At the ends of this auxiliary negative return of old rails, copper waterproof cables were connected to join the ends of the track rails. The connection made here and the connection between this auxiliary rail return and the negative bus-bar are shown by diagrams. A reduction in kilowatt hours output of 2¼ per cent has been obtained.—*St. R'y Jour.*, Jan. 4, and Internat. Ed., Jan.

Electric Locomotives.—An illustrated description of two electric locomotives built by Thomas Parker, one of standard gauge for use in hauling cars about an industrial establishment, and the other a very small narrow-gauge mining locomotive. The larger locomotive is provided with center and side hooks for attaching it to its load and is intended to operate on 200 volts. There is only one motor placed in the center and geared to both axles. Above this motor is a pulley block so that it may be removed from its position below the foot board without resorting to the use of a crane. This renders any repairs necessary very easy. The locomotive is provided with sand boxes and powerful brakes and is operated by an ordinary tram-car trolley.—*St. R'y Jour.*, Int. Ed., Jan.

Storage Battery Electric Locomotive.—An illustrated description of a locomotive of British make, equipped with sixty accumulators having a capacity of 525 amp. hours. The cells are claimed to be unaffected by vibrations and free from buckling or breaking of the plates. The positive block is formed by a variation of the Plante process; and the negative consists of a series of cylinders which are inserted in holes punched in the positive plates. The locomotive has four wheels and two motors which are geared to the axle by a double reduction having a total ratio of 20 to 1. It has been found that in use around a factory there is much less risk of fire than with a steam locomotive as well as a considerable saving in labor.—*St. R'y Jour.*, Int. Ed., Jan.

REFERENCES.

Determining the Resistance to Traction.—An article illustrated by diagrams. The best method of measuring with an automobile is to run it at a known speed on a level road, to suppress quickly the driving force and measure the time until the automobile is at rest. These measurements are repeated for various values of the initial speed. The tests can be shortened by measuring the time required to pass from one speed to another speed. He shows how to calculate the resistance to traction from these measurements.—*L'Eclairage Elec.*, Nov. 30.

Energy Consumption of Cars.—GUEROULT.—The first part of a mathematical article in which he determines the average consumption of energy of a car per hour or day, as a function of weight, average normal speed, number and duration of stops, coefficient of friction, and the size of the wheels.—*L'Eclairage Elec.*, Dec. 7.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Electrical Energy.—ESSON.—An article on "principles and profits in electric supply." He severely criticizes the Wright maximum demand system. He says it is absolutely impossible to devise a practical system by which every consumer would be charged with strict regard to equity. The aim of the business is to sell the greatest possible number of units per year without increasing the total capacity of the plant, i. e., to improve the load factor. Wright claims that the maximum demand system has this effect, but others say that a flat rate gradually reduced as the business of the station increases, is equally effective. It is admitted on all hands that the maximum demand system of charging is most unpopular, that it leads to endless disputes, and that the ordinary consumer is quite incapable of understanding it. The great objection to the system lies in the fact that the number of units which the consumer has to pay for at the high rate is never twice the same, is always changing and is a function of nothing connected with his installation of which he has knowledge. In this regard Andrews' system is simpler; he charges a flat rate for the current with a fixed charge per lamp per year in addition. But as the varying charge basis is in Wright's system an objection, so is the heavy deposit per lamp in Andrews'. The present author suggests adopting a basis of units per lamp per year. So many units per lamp per year would be charged at a comparatively high rate, while units consumed over and above these would be charged at a comparatively low rate. Or a system of rebates or discounts on a flat rate may be used. The foregoing remarks apply to stations owned by private companies. For municipal stations he suggests that every ratepayer should pay "for the inestimable boon of having the means to a healthy and pure artificial light brought to his doors." The standing charges should be met by a general rate levied on all ratepayers in the compulsory area, while the production charges should be met by a flat rate for current supplied.—Lond. *Elec.*, Jan. 3.

Economy of Isolated Electric Plants.—PARSONS.—An account of what appears to have been a careful examination of the relative advantages of isolated plants and electricity supply from central stations, from actual records of cost. Over 250 buildings with isolated plants in New York were visited, but only 17 were found where reliable information in every particular was available. Only

these were considered in the analysis of the cost records. Those of five office buildings are analyzed in detail; and as they include one of the largest office buildings in New York, one of the smallest, and three buildings of average size, they cover the field fairly well; they indicate as a rule the marked superiority in economy of the isolated plant, but in one case it is shown that a slight error of installation combined with unfavorable load conditions may, even in the very largest buildings, render the isolated plant of doubtful economy. The next class of buildings considered is the loft buildings; from the figures given for three loft buildings it appears that the installation of a plant in a building of this class and the sale of current to the tenants at central station rates, or in very large loft buildings, at 10 per cent to 25 per cent reduction from those rates, would in most cases prove very profitable. Figures are then given regarding a department store, showing a very great advantage in the installation of the isolated plant, and with the two important points in its favor, that the average load factor is quite high and that a steam plant is a necessity whether the electric plant is installed or not, there seems little doubt of the advisability of its installation in the department stores.—*Eng. Mag.*, Jan.

Electric Distribution from Central Stations.—Snell.—An abstract of his presidential address to the Newcastle Section of the (Brit.) Inst. Elec. Eng. He criticises the schemes of supplying power in bulk. "Where there are a number of small towns, each of which with, say, 10,000 or less inhabitants, and possibly the demand for a network of interconnecting light railways, it would undoubtedly be a waste of public money to put down separate sets of plant for each little place. In such a case it is probably the most rational method to adopt a station common to them all. But where a town has a population of, say, 20,000 or more inhabitants, it deserves consideration whether it may not be cheaper and better to install a local station, rather than take energy in bulk from a distant one, and then after transformation to distribute it locally. The all important advantage claimed for these county stations is an improved power factor, but the writer fails to see how in the same latitude the summation of a number of small peaks is going to result in an improved load curve; and yet upon this factor all depends." He strongly advocates the larger use of storage batteries. The guiding principle in designing stations ought to be simplicity. He believes that "ultimately a plain two-wire system of distribution will be preferable to a three-wire distribution now so universally employed. The effect of the cost of insulation and the comparatively large balancing wire required in practice—much larger than is demanded in theory—levels the economy down that is said to be gained in a three-wire system enormously, and the effect on insulation of the negative cable, by putting a permanent stress upon it, and the effect of osmosis, caused by earthing the middle wire, does, the writer knows from experience, cause a much heavier rate of depreciation on that cable and the negative service leads, which more than counterbalances the economy thought to be gained."—Lond. *Elec. Rev.*, Dec. 27.

San Francisco.—A very long and well illustrated description of the power plant of the Independent Electric Light & Power Company in San Francisco. The electric system is characterized by two-phase generation, three-phase transmission and a distribution enabling one to obtain two-phase current at either 115, 230, 440, or 2300 volts, and direct current on the three-wire system at either 110, 220, or 440 volts, and alternating current arc lighting on either the constant current or constant potential circuits. The electric equipment of the power-house consists of three 1500-kw and one 500-kw two-phase generators; two 100-kw direct-current dynamos as exciters and seven 750-kw raising transformers. An additional 1500-kw generators has been ordered. The frequency is 500 volts two-phase.—*Jour. of Elec.*, Dec.

REFERENCES.

Systems of Distribution by Alternating Currents.—Guilbert.—An article, giving brief ilustrated descriptions, taken from patent specifications, of systems of C. F. Scott, Lamme, Steinmetz, E. Thomson, Potter, Davis, Sunt, Reed and Farrar.—*L'Eclairage Elec.*, Dec. 14.

Transformer Sub-Stations.—Winawer.—An illustrated description of the transformer stations in Karlsruhe. Thirty-six are above the ground in boxes and contain two 30-kw transformers each, 5 are underground and 10 are placed in houses.—*Zeit. f. Elek.*, Dec. 22.

Lightning Arresters.—Klein.—An illustrated description of horn lightning arresters, partially surrounded with iron to give the lines of force a desired direction.—*Elek. Zeit.*, Dec. 19.

Wires, Wiring and Conduits.

Overhead Transmission Lines.—Loppe.—A long mathematical paper on the design of overhead high-tension transmission lines. Each insulation represents a weak point for the insulation of the line, so that the greater the distance between two consecutive poles, the better; on the other hand, the mechanical strength of the line and the first cost must be taken into consideration. The influence of the variations of the temperature and the stress is discussed at some length, and the general considerations are given for determining the lengths of spans which may be allowed. The paper is too mathematical to be abstracted. Numerical examples are given.—*Bull. de la Soc. Int. des Elec.*, Aug., Sept., Oct.—An account of the discussion which followed and in which Roux, Arnoux, Boucherot and Loppe participated, in *Bull. de la Soc. Int. des Elec.*, Dec.

Electro-Physics and Magnetism.

Barlow's Wheel.—Carvallo.—To determine the motion of a system of movable circuits and the currents which traverse them, Maxwell uses the equations of Lagrange. The expressions adopted for the kinetic energy is composed of two parts, these being the force of inertia of ponderable matter, and the function of electrodynamic forces, called the electrokinetic energy. This would mean that the electrodynamic forces and the induced e. m. f.'s, are not applied forces, but forces of inertia. The present author, however, shows that the equations of Lagrange break down in a case such as that of Barlow's wheel, for if correct the wheel should stop rotating. He finds in the behavior of Barlow's wheel a confirmation of Maxwell's contention that the energy of a system of currents is a kinetic energy, whereas the electrodynamic forces and the induced e. m. f.'s are forces of inertia.—*Comptes Rendus*, Dec. 2; abstracted in Lond. *Elec.*, Dec. 27.

Induced Radio-Activity.—Curie and Debienne.—All bodies become radio-active when they are placed in a closed vessel with the solid salts of radio-active barium. They have found that the effect produced can be increased 40 times, and also rendered more regular, by replacing the solid salt by its aqueous solution. They have made a number of striking experiments with substances placed in what they call an "activating enclosure," i. e., a vessel containing a radium compound.—*Comptes Rendus*, Dec. 2; abstracted in Lond. *Elec.*, Dec. 27.

Radio-Activity and Luminescence.—De Hemptinne.—Results of experiments showing that a gas which becomes luminous at a certain low pressure under the influence of electrical vibrations, becomes luminous at a higher pressure when exposed at the same time to the action of X-rays. Radium rays have a similar effect.—*Comptes Rendus*, Dec. 2; abstracted in Lond. *Elec.*, Dec. 27.

Permanent Magnetism.—Abt.—An account of a determination of the permanent magnetic moments of a number of specimens of steel manufactured at the Resitza iron works of the Austro-Hungarian Railway. The collection of steels comprises 10 carbon steels, two manganese steels, six steels with a specially high percentage of manganese, six chromium steels, and two nickel chromium steels. The tables of figures show that the mangetic moment reaches a maximum with a magnetizing current of 20 amp. But the maximum in the case of the strong manganese steels is already attained with 10 amp. The latter also has the smallest permanent magnetic moment. The highest permanent magnetism is shown by the nickel chromium steel, the ratio of the two permanent magnetisms being 22.5 in the case of long bars and 17.6 in the case of short bars. One particular brand of manganese steel containing much manganese shows no permanent magnetism at all, however great the magnetizing current. —*Ann der Physik*, No. 12; abstracted in Lond. *Elec.*, Dec. 27.

REFERENCES.

Skin Effect of Electrical Oscillators.—Chant.—An illustrated account of an experimental investigation of the skin affect in electrical oscillators; both cylindrical and spherical oscillators were tested. The results are given in a table. It appears that both in the case of the cylindrical and of the spherical doublets, the excessively thin gold leaf shells were quite as efficient as the solid metal bodies.—*Am. Jour. Sc.*, Jan.

Hertzian Exciters and Resonators.—Poincare.—A brief article criticising a recent article by Johnson on this subject.—*L'Eclairage Elec.*, Nov. 30.

Terrestrial Magnetism.—The December issue contains a paper by

Gilbert on some experiments upon the relations between ether, matter, and electricity; reports by Boergen, Eschenhagen, Hepites, Haga, Fraser, de Moidrey, Farr, Hosmer, Claxton, on the magnetic observations made during the total solar eclipse of May 17, 1901; an obituary notice, with portrait, of Prof. Eschenhagen; a communication, by de Moidrey, on magnetic observations in Southeast China; an illustrated description, by Watson, of a set of magnetographs designed by him; and an article, by Hazard, on the central physical observatory of Russia.—*Terr. Magn. and Atm. Elec.* Dec.

ELECTRO-CHEMISTRY AND BATTERIES.

Mineral Production and Chemical Industries in 1899.—Statistical articles and summaries, comprising nearly the entire issue; many refer to the production of the world, but most of them to the United States; they deal with gold and silver in 1901; mines in California, Leadville, San Mignel Co., Utah. A review, by Wells, of the progress in the cyanide process. Iron and steel in 1901; the different markets in the United States. In 1900, the United States produced a total of 600,832,000 lbs. of copper, including copper in its sulphate; in 1901 the production was 595,000,000 lbs.; this is a moderate decrease, for the first time in a number of years. The production of aluminum in 1901 is assumed to have been larger than in 1900, although the Pittsburg Reduction Company does not give out figures. Other articles deal with lead, zinc, tin, mercury, nickel and cobalt, platinum, coal, bauscite, the chemical market in 1901, the mining industries of British Columbia, Western Australia.—*Eng. and Min. Journ.*, Jan. 4.

Tests of Aluminum Bronzes.—TETMAYER.—An account of tests made in the Zurich Polytechnic School at the request of the Neuhausen Aluminum Company, who provided the samples. The specific gravity first rises and then falls, as the percentage of aluminum increases. The maximum strength for soft alloys was obtained with 3.4 per cent Al, and for hard alloys with 1.4 per cent Al. For brass, the electricity decreases with the increase of Al, and is extremely low with 2 per cent of the latter. Silicon increases the specific gravity and reduces the elasticity. Iron, in the proportion in which it was present in the alloys, was not observed to sensibly influence the physical characteristics. Aluminum bronze, containing 10 per cent Al with 1.5 per cent Si and Fe, is too brittle to be of any practical value. As regards the abrasion by friction, the hard alloys, with less than 89.6 per cent Cu, lose little in weight, while the soft alloys, with less than 6 per cent Al, heat and wear away rapidly.—*Rev. de l'Elec.*, Aug. 31; abstracted in *Science Abstr.*, Dec.

Electrical Recovery of Pure Tin from Waste Tin Cuttings.—GELSTHARP.—An illustrated description in detail of a process which is said to have been successful in a practical trial. The tin is recovered by electrolysis, and the clean iron is either sold as best scrap or converted into green copperas, which may be further converted into red oxide and Nordhausen sulphuric acid, the profits derived therefrom being exceptionally large. The electrolyte in the stripping tanks is a 1¼ per cent solution of commercial de-arsenicated spirit of salt, to which is added a small quantity of oil of vitriol.—*The Elec. Chem. and Met.*, Dec.

REFERENCES.

Potentials of Electrodes.—HABER.—A long article giving highly theoretical notes on the notation of the potentials of electrodes and on the calculation of the potential difference at a reversible electrode, several types of reversible electrodes being discussed in detail. He discusses especially the process in so-called oxidation and reduction cells.—*Zeit. f. Electrochemie*, Dec. 5.

Preparation of Semi-Permeable Membranes.—MORSE and HORN.—A description of a method of making strong semi-permeable membranes of copper ferro-cyanide in the walls of porous cells, by means of electrolytic deposition.—*Chem. News*, Aug. 30; abstracted in *Science Abstr.*, Dec.

Aluminum.—WILSON and MORRISON.—Longer abstracts of the two papers of these authors, recently noticed in the Digest.—Lond. *Elec.*, Dec. 27.

Non-Aqueous Solutions.—CIOMMO, WALDEN and CENTNERSZWER, FRANKLAND and FARMER, FRANKLIN and KRAUS.—A review of several investigations by various authors, of the electrolysis of non-aqueous solutions.—*Zeit. f. Elektrochemie*, Dec. 12.

Conductivity of Solutions in Glycerine.—DE CIOMMO.—An account of measurements of the conductivity of strong solutions of caustic soda and potash in glycerine of fixed strength, namely, 96 per cent glycerine, and 4 per cent water.—*Nuo. Cim.*, Aug.; abstracted in *Science Abstr.*, Dec.

Pan-American Exposition.—NORDEN.—A review of the electrochemical exhibits at the Pan-American Exposition in Buffalo.—*Zeit. f. Elektrochemie*, Dec. 12.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Alternating Current Terminology.—Some further contributions to the discussion on alternating current terminology which has begun in that journal by Hospitalier, as noticed recently in the Digest. The Academy of Science of Toulouse suggests the following terms, instead of those put in parenthesis which had been proposed by Hospitalier: if U and I are what is called in this country effective e. m. f. and effective current, and "*a*" the phase difference between e. m. f. and current, the propositions are as follows: U I, "effective power" (Hospitalier: apparent power); I cos a, "intensity in phase" or "useful intensity" (current in phase); I cos a, "intensity out of phase or "useless intensity" (current in quadrature); U I cos, a "power in phase" or "useful power" (real power); U·I sin a, "power out of phase" or "useless power" (frictive power); sin a, "coefficient of uselessness" (factor of impotence); "*a*," angle of phase difference" or "angle of uselessness"; $U \div I$, "effective resistance."—Some critical remarks by Raverot on the method of resolving a vector into its components, as current into the current in phase and the wattless current; he says that from the point of view of the physicist, there is nothing more artificial than this method of representation. He urges looking after the exact physical meaning of power in alternating current phenomena and to suppress a certain number of "fictive and even parasitic" definitions.—*L'Ind. Elec.*, Dec. 25.

REFERENCES.

Measuring Instruments.—ARMAGNAT.—An article, giving brief illustrated descriptions, taken from patent specifications, of electrometers, devised by Townsend, Wilson and McClelland, E. Thomson; galvanometers by Steele; Rimington; Davis and Conrad; Atkinson, Waddell; a compensation voltmeter of Th. Duncan for measuring the loss of voltage in the main feeders of a distribution network.—*L'Eclairage Elec.*, Dec. 7.

A continuation of his article giving brief illustrated descriptions, taken from patent specifications, of the following new instruments and methods of measuring; a device, by Mershon, for measuring at any part of an alternating current network, the potential difference at another point; a resistance box of Fleming for industrial measurements; a Wheatstone bridge with automatic regulation by Darwin, Griffiths, and Whetham; a device by Goddin for registering the indications of instruments with a feeble directive force.—*L'Eclairage Elec.*, Dec. 21.

Terrestrial Magnetism and Instruments of Precision.—WINDMUELLER.—An illustrated account of experiments in which he investigated the influence of the field of terrestrial magnetism upon instruments of precision. For very accurate instruments this influence must be taken into account. The instruments tested by the Reichsanstalt have a mark showing in which direction to the field of terrestrial magnetism the instrument has been tested.—*Elek. Zeit.*, Dec. 26.

Uniformity of Speed During One Revolution.—BLONDIN.—A paper on the methods of measuring the degree of uniformity of speed during one revolution and the maximum angular displacement. He recommends the use of the stroboscopic method, in combination with the photography of the curves.—*L'Eclairage Elec.*, Nov. 16.

Application of Oscillographs to the Study of Alternators.—BLONDEL, DOBKEVITCH, DURIS, FARMER, and TCHERUOSVITOFF.—A full reprint, with many illustrations of their paper presented to the Internat. Elec. Congress in Paris, noticed in ELECTRICAL WORLD AND ENGINEER, Sept. 15, 1900; *L'Eclairage Elec.*, Dec. 14.

Analyzing Alternating Current Waves.—JANET.—A brief illustrated mathematical paper on an apparatus of Coradi for determining the constants in Fourier's series into which a given alternating wave can be resolved.—*Bull. de la Soc. Int. des Elec.*, Nov.

TELEGRAPHY TELEPHONY AND SIGNALS.

Telegraphy.—An editorial discussion of the possible development of commercial telegraphy in the near future. Statistical data from Germany are given which shows that there is no general need for

high-speed telegraph systems. But it would be good to provide a few very important lines—especially those for international service—with a high-speed service. Of the countries from which statistical data are published, it is only England and Turkey in which the income from the telegraphs is greater than the costs, while in Belgium, Norway, Switzerland and Spain the costs exceed the revenues. To cheapen telegraph service, it would be necessary first to diminish the number of attendants. It has been found possible with the Rowland system for one attendant to care for four receiving instruments. Attention is called to the suggestion of Koller that telegrams should be delivered to the telegraph station in the form of perforated tapes; the number of attendants could then be reduced to one-fourth and the fees could be reduced to one-half. What is wanted now is a simple and cheap instrument for this purpose.—*Elek. Zeit.*, Dec. 19.

REFERENCES.

Baudot Multiple Telegraph System.—ROBICHON.—An illustrated description of portable Baudot instruments. They were made use of during the recent visit of the Russian Emperor to France, in order to fulfill the enormous telegraph service in lines which were otherwise not much used.—*Jour. Teleg.*, Dec. 25.

Statistical.—Statistical articles on the telegraph and telephone cables in Germany; and on telegraphy and telephony in Russia in 1899.—*Jour. of Teleg.*, Dec. 25.

MISCELLANEOUS.

Electricity and the Growth of Plants.—HEBER.—An illustrated account of some experiments showing the beneficial influence of electric currents upon the growth of plants. Electrodes were put in the soil at different sides of the plant and a direct or intermittent current sent through the soil from an external source, or a zinc and a carbon electrode were placed at opposite sides of the plant and connected by a wire so that a short-circuited cell was formed.—*Elek. Anz.*, Dec. 15.

REFERENCES.

Electrochemist and Metallurgist.—This British Journal is in future to be published bi-monthly instead of monthly.

Lightning, Electrical Times.—The London weekly journal, which up to 1900 appeared as *Lightning*, and last year as *Lightning, the Electrical Times*, will hereafter appear as *The Electrical Times.*

New Books.

LES APPLICATIONS PRATIQUES DES ONDES ELECTRIQUES. By Albert Turpain. Paris: C. Naud. 412 pages, 271 illustrations. Price, 12 francs.

This most recent work on wireless telegraphy is a thoroughly up-to-date, comprehensive and, what is more to the point, a practical work on the subject, dealing as it does not so much with the historical progress made in etheric wave telegraphy since 1897 as with the practical methods involved in sending and receiving wireless messages. Any attempt, however, to adequately describe the phenomena attendant on the wireless transmission of energy must necessarily begin with the experiments in electric undulatory motion discovered by Hertz and the effects of electric waves upon segregated metals as embodied in the investigations by Branly. For this reason the author has devoted the first chapter to the production and observation of these waves. To those who are familiar with Hertz's work on "Electric Waves," describing his own experiments with the Reiss micrometer spark-gap detector the first part of Turpain's Telegraphy Without Wires, will be especially appreciated, for the descriptions he gives of the detectors are very exact and with the detailed drawings accompanying the text they are much more lucid than in the memoirs of Hertz. After Hertz published the results of his researches his work was rapidly reproduced and advanced by MM. Sarasin and de la Rive, Blondolot, Righi, Lodge, Branly and other noted physicists; the work of all these scientists Turpain reviews briefly and as thoroughly as the practical nature of the book requires.

In the second chapter of the author rehearses at length the available modes and sources of e. m. f. suitable for the production of the disruptive discharge. These include the static machines of Holtz and Wimshurst, following which is a very complete list of the various induction coils constructed according to the plans and specifications of Apps, Elihu Thomson, de Rochefort and others. The superiority of the induction coil over the static machine, Turpain points out, arises from the necessity of employing a motor and battery in conjunction with the latter to operate the revolving discs, whilst he maintains that the steadiness of the current discharge of the electric machine is advantageous. An induction coil is so much more portable, convenient and compact that it is doubtful if it will ever be replaced by the more cumbersome glass plate machines.

To the subject of interrupters Turpain devotes much space and gives many drawings. There are over a dozen different forms described, commencing with the simple mechanical vibrator and running the whole gamut of ingenious contrivances devised for "making" and "breaking" the primary circuit of a coil, with the greatest efficiency. In systems of wireless telegraphy the value of means for suddenly breaking the primary is often overlooked or under rated; nearly all coils are equipped with interrupters of very ordinary construction and usually are far from the high standards necessary for producing the maximum effect with the minimum amount of energy. The interrupter and condenser of a coil should be in proper adjustment relatively, as well as with the coil with which they are used, or the spark emitting the waves will be enfeebled. The interrupter then is as essentially vital to the good working of the system as the coil itself or the coherer, and even more so, since the maximum efficiency of the spark depends largely upon the interrupter, and the more sudden the break the steeper will be the wave front of the oscillatory discharge and, therefore, the greater the energy with which the waves are emitted, and, finally, the distance covered. Turpain classifies interrupters as follows: (1) Tremblers or mechanical vibrating; (2) rotators or mechanical contact revolving; (3) turbines or mercurial jet; (4) electrolytic. The various forms of mercurial turbine interrupters based on centrifugal force so much in vogue in Europe are considered in the text, as well as the complete specifications and drawings of the Wehnelt electrolytic interrupter; a multiplicity of improvements upon the original form—either real or fancied—are described with much attention to detail. It will thus be seen that, owing to its importance in connection with wireless telegraphy, there is method in the amount of space allotted to interrupters by the author.

Another feature that gives the reader a clear conception of what has been done in the way of spanning distances by the various systems is a compliment of authentic tests giving the height of the vertical wires or antennæs, the distance between the stations, and where and when the tests are made among the more important, are those made by Marconi, Slaby, Ducretet and others. The results show that the Italian inventor succeeded far ahead of his contemporaries in his efforts to establish a "long-distance" record. The experiments of Tesla and Thomson with high-potential, high-frequency currents are treated quite fully considering the limited part they have played in wireless transmission, but according to M. Turpain their application to wireless telegraphy is practical if their apparatus is constructed for this specific purpose. Those who have witnessed Tesla's experiments with 20-meter spark lengths will find this section very interesting if not indeed instructive, especially in view of the fact that great things have been claimed for and are seriously expected of the Tesla system in this country. From the many reports concerning the adaptation of his apparatus for long-distance transmission of intelligence without connecting wires, as well as the very recent Tesla patents issued, it would seem that Turpain has some justification for his favorable views.

Nearly one-half of the book is taken up by an appendix describing apparatus relating to coherers, occasionally to divers topics appertaining to the art, but more chiefly to the analysis of recent patents granted to inventors in the United States, France, England and Germany. Turpain does not critically consider to any extent the various appliances and apparatus, but describes them with characteristic French clearness and conciseness, which, together with the accompanying drawings—the greater number are in outline or diagrammatic—practically eliminates all chance of misunderstanding the author or shrouding in obscurity the topic. Mathematics are almost entirely avoided as well as the underlying theories involved. In the chapter on Hertzian waves appear some formula, and the only part which may be designated as theoretical is that relating to the several solutions offered by different physicists to account for the propagation of electric waves, wherein they seemingly defy the laws of light in following the curvature of the earth—if they really do—and what the constants of the earth may be.

M. Turpain has given us a work that is what he himself claims for it—a work based not on theory but on the practical results obtained by the many workers in every land on this fascinating subject. To those who are working along this line a study of Turpain's

book offers much useful information not readily available otherwise. To others who have only a passing interest in wireless telegraphy it will serve to broaden their views of what the European workers, especially, have done to advance this new art.

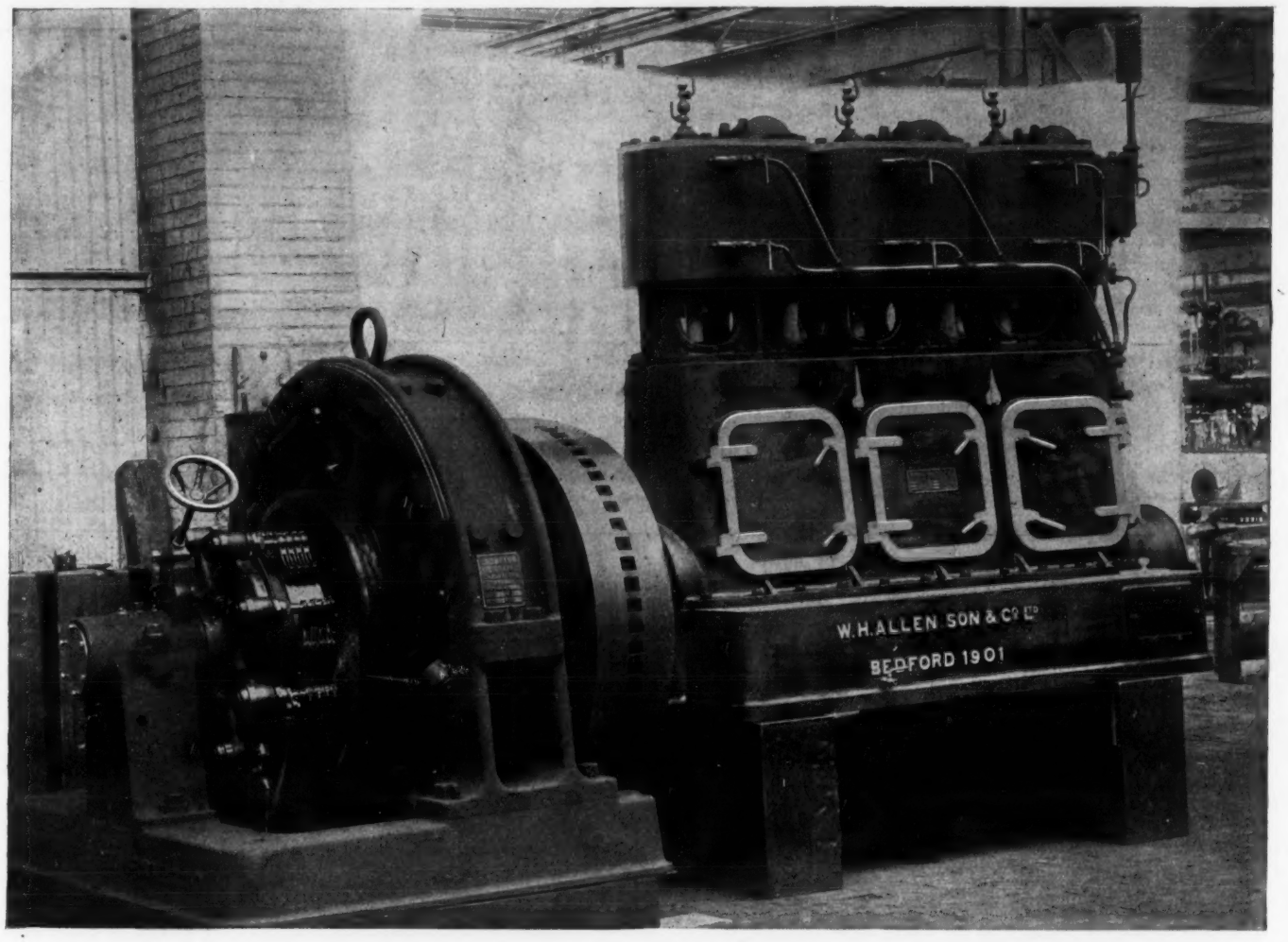
With Fahie's "History of Wireless Telegraphy," Lodge's "Modern Views of Electricity" and Turpain's "Les Applications Practiques des Ondes Electriques Telegraphie Sans Fils," the nucleus of a library of a new art may be had covering virtually everything known in the state of the art of wireless telegraphy up to the present time.

BOOKS RECEIVED.

MUNICIPAL ENGINEERING AND SANITATION. By M. N. Baker. New York: The Macmillan Company. 317 pages. Price, $1.25.

English High Speed Engines for Electrical Generation.

The accompanying illustration shows a type of engine designed for electrical generation by W. H. Allen, Son & Co., of Queen's Engineering Works, Bedford, England. It is of the three-cylinder compound type, and especially designed to maintain a high efficiency under varying loads. As illustrated, the engine is direct connected to a Crompton direct-current generator, having a normal output of 435 amperes at 460 volts and 450 r. p. m.



ENGLISH ENGINE FOR ELECTRICAL GENERATORS.

The shaft is forged from a solid bloom of Siemens-Martin steel, the eccentrics being also solid with the shaft. A considerable advantage is claimed in having the crank-shaft and eccentrics solid at high speeds, as the number of independent moving parts is thus reduced to a minimum. In order that the high speed may be maintained for a considerable time, the engine is fitted with a system of forced lubrication, a small pump of simple and efficient design and driven direct from the engine being placed inside the bed plate for this purpose.

The valves are of the solid piston type, and take steam on the inside edges, thereby diminishing the pressure on the glands as compared with valves taking steam on the outer edges.

The governor is of the centrifugal kind, with controlling springs fixed direct on the end of the crank-shaft, and revolving with it. It is connected by means of an arrangement of levers to the throttle valve, which is immediately above it, and is so arranged that the speed of the engine can be varied by the attendant within 5 per cent above and below normal speed while the engine is running, if it be desired.

The length of the engine bed is 94 inches, width 54 inches, and height from the lower edge of the base-plate to the top of cylinder covers 86 inches. The small space occupied by this class of engine for the power given out is thus very noticeable, and, as will be seen from the tests, particulars of which are given below, there is no sacrifice of the efficiency of the engine, while the steam consumption compares favorably with, and is, in fact, better than many first-class two-cylinder compound engines of the same power. The engine is fitted with a governor acting direct on the throttle valve, with the view to reducing the variation in speed to a minimum in the event of the whole or any portion of the load being suddenly thrown on or off, the stop valve remaining full open under all conditions.

Following are the data of a trial run of six hours: Steam pressure, 150 lbs. at stop valve; mean ihp., 308.8; revolutions, 451.3; water per ihp., 16.4.

On the governor trials, with stop-valve full open, the mean speed at the moment before breaking the circuit was 448 r. p. m.; on throwing off the whole load, amounting to 261.5 ehp., the speed rose steadily to 475 r. p. m., and then settled at 453 r. p. m., the duration of time from throwing off the load to settling being about 5 seconds. It will thus be seen that the maximum variation was 5½ per cent, while the settling speed only showed a rise of 1 per cent above the mean speed. For the half-load test the mean speed of the engine was 448 r. p. m. prior to the removal of the load, which rose to 470 on breaking the circuit, and settled at 464, the time being about 4 seconds.

Messrs. Allen & Co. have designed for the larger sizes of their engines a by-pass valve, operated by the governor spindle, which, when the engine is operating an overload, allows high-pressure steam to pass into the receiver and so help the low-pressure cylinder.

Electric Features of a Modern Hospital.

Mr. John Pierpont Morgan has presented to the Society of the Lying-In Hospital of New York City a magnificent new hospital and equipment just opened for public use. The building is on Second Avenue and Eighteenth Street, is eight stories high and rises 150 ft. from the sidewalk. It embodies a great many features of novelty, including electrical, and is perhaps the furthest reach in modern medical and surgical skill, so far as equipment is concerned. The well-known

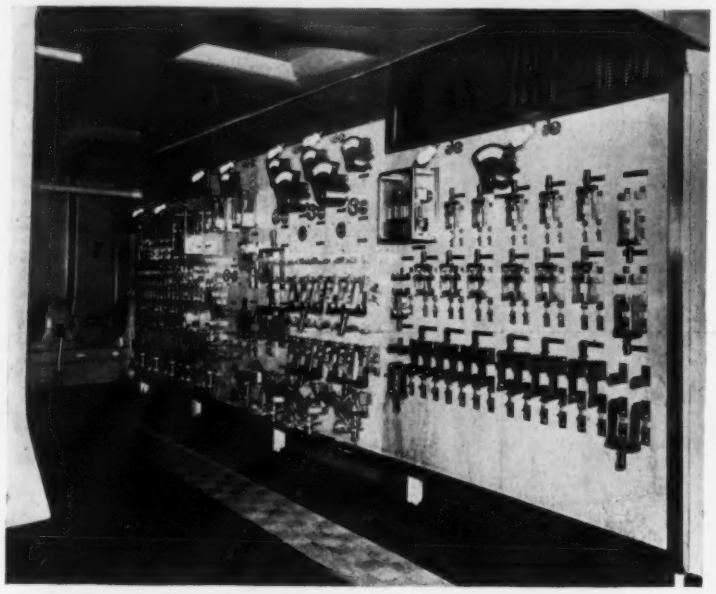


FIG. I.—THE SWITCHBOARD.

physician, Dr. J. W. Markoe, who is responsible, we believe, for much or all that has been done, is to be congratulated on the admirable results.

While the electrical features are not in many respects new, it may be noted that at every turn one finds some electrical system or device in operation to enhance the welfare of the patients and staff. The building has a complete electric light and power plant of its own, with Babcock & Wilcox boilers, Phœnix engines and three Westinghouse direct-current, direct-connected generators of 200 kw, 150 kw and 100 kw, respectively, supplemented by a "Chloride" equipment from the Storage Battery Company of 2500 ampere-hour capacity, fed through

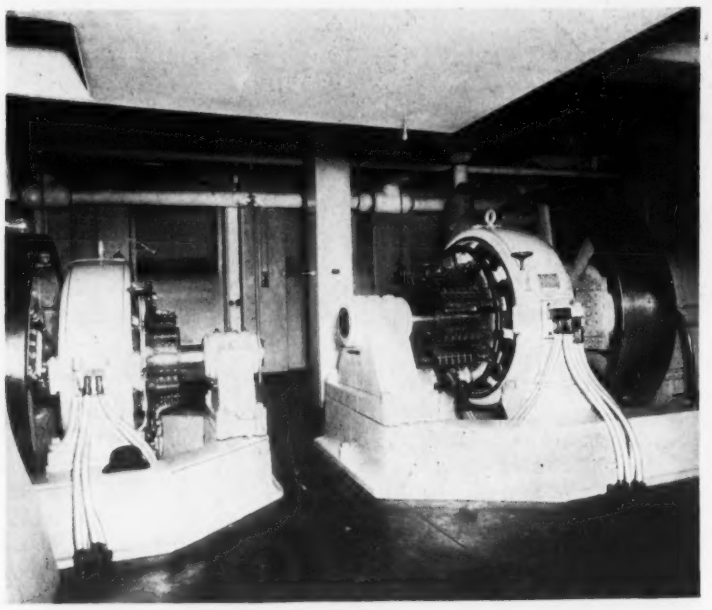


FIG. 2.—GENERATING PLANT.

a 10-kw motor-driven booster. The smokestack runs up through the center of the building with a huge spiral stairway, and constitutes also a ventilating and sanitary flue. There are four Sprague electric elevators, three dumb waiters and one ash lift. No fewer than 27 electric motors for various purposes are in use, chiefly, if not all, of C & C make, and aggregating about 270 hp, ranging from 1 up to 35 hp. The very handsome switchboard was built by the General In-

FIG. 3.—AUXILIARY BOARD.

candescent Arc Light Company and the wiring in iron duct, etc., was done by the Western Electric Company. There is a small auxiliary

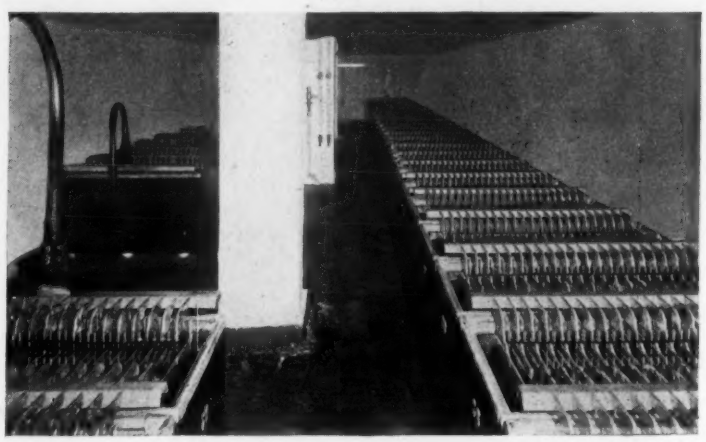


FIG. 4.—STORAGE BATTERY.

board and system by which the bells and annunciator system are rung by a Crocker-Wheeler ringing motor-generator, which, when

FIG. 5.—INVERTED ELECTRIC LIGHTS IN ONE OF THE WARDS.

current happens to be off from the generating plant automatically cuts out itself and cuts in a primary battery outfit to do the work. All told, the plant affords service for about 3200 lamps of 16 cp.

One of the most noteworthy features of novelty is the introduction

by the Electric Regulator Company of the Sayles regulator for dimming the lights in all the wards and a number of the private rooms. There are, we believe, no fewer than 32 of these equipments, and the hospital is the first installation of this ingenious device, which has already been described and illustrated in our pages. In the rooms the lights are in the ceiling, masked by ground glass bulls-eyes; in the wards the lights are carried on long, plain stems, with an inverted hood or septum, not transparent, and throwing all the light up to the ceiling. The fixtures are usually of 2, 4 or 6 cluster lights, governed by metallic push panels, and the Sayles regulator box of metal adjoins, all setting flush with the wall. The regulator gives three steps, the first "making darkness visible," then up to the full candle-power, and the convenience of the device is so apparent upon the first glance that its general adoption in all such institutions seems inevitable. It is difficult to imagine wards better lighted, without glare, or more softly dark when the dimmers are in use.

Another feature is the electric ambulances, for which there is a separate charging board. In this form of vehicle the side opens up and is raised while the mattress runs out on the supporting lower

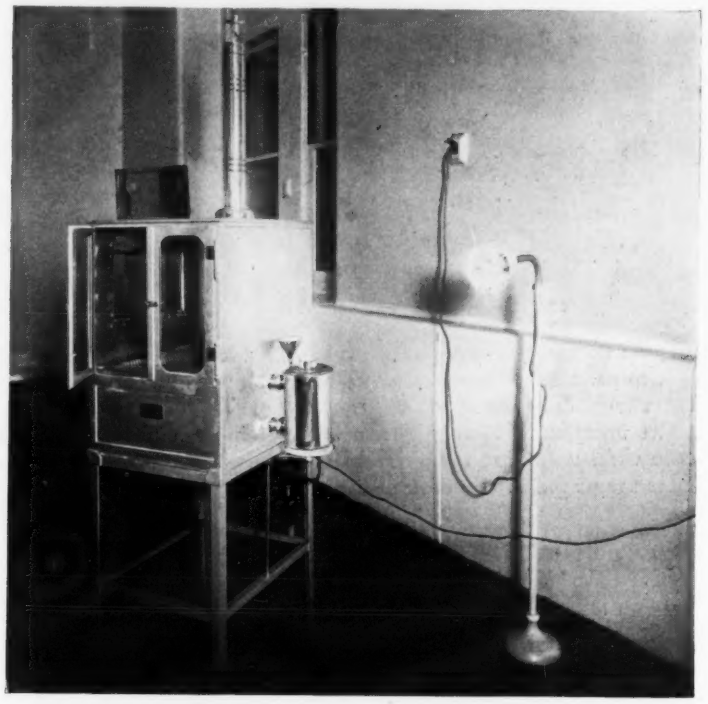


FIG. 6.—ELECTRICAL INCUBATOR.

half. The convenience in handling patients is remarkable. We may add that Mr. C. O. Mailloux is the consulting engineer of the plant, which was installed under his direction, assisted by Mr. Charles E. Knox. The chief engineer operating the plant, to whom we are indebted for information, is Mr. J. George Hermes.

The Development of "Oscillating" Electric Fans.

In itself the electric fan motor has been one of the most notable successes among inventions and industries, selling by the hundreds of thousands, making a new market for current, and mitigating in a manner that every American appreciates the fierce heat of the summer. It is only natural that several and various changes from the original and standard form should be made, and concurrently with marked and rapid improvements in design and construction there have been seen many novelties and some curiosities. One of the most praiseworthy lines of improvement has been that which proposes the better distribution of the breeze from the fan. A great many people object to the steady uni-directed blast from the fan, aimed steadily at one part of the room, one human being, and but one portion of his upper anatomy; and a well-known electrical engineer has gone so far as to characterize stationary fan motors as "pneumonia screws." It was to meet objections of this nature that Mr. T. Romer Weyant, a well-known inventor of this city, brought out last year a device that attracted considerable attention, in which with vertical feathering fan blades and checked in its swing by a chain, the fan was able to deliver its breeze, as it oscillated, to every occupant of a large room. He has now made another considerable stride in a fan motor that is being introduced for 1902 by the Shedd Electric & Manufacturing Company, of 136 Liberty Street, New York City. Last year the company bought fans in the open market and equipped them with its oscillating devices, but for the season now opening they have produced a complete equipment of their own that is more than usually deserving of notice.

The new motor is remarkably compact and efficient, and its neatness of design can be seen from the accompanying cuts. It is enclosed but not exactly "iron clad," the openings between the bi-polar field and the armature being so contrived as to keep a constant stream of air in large volume passing through the machine, with consequent minimization of heating. The armature has a rose, or end-on commutator, and by this means the carbon brush tubes are placed parallel with the fan shaft. The pull of the fan driving the air from the

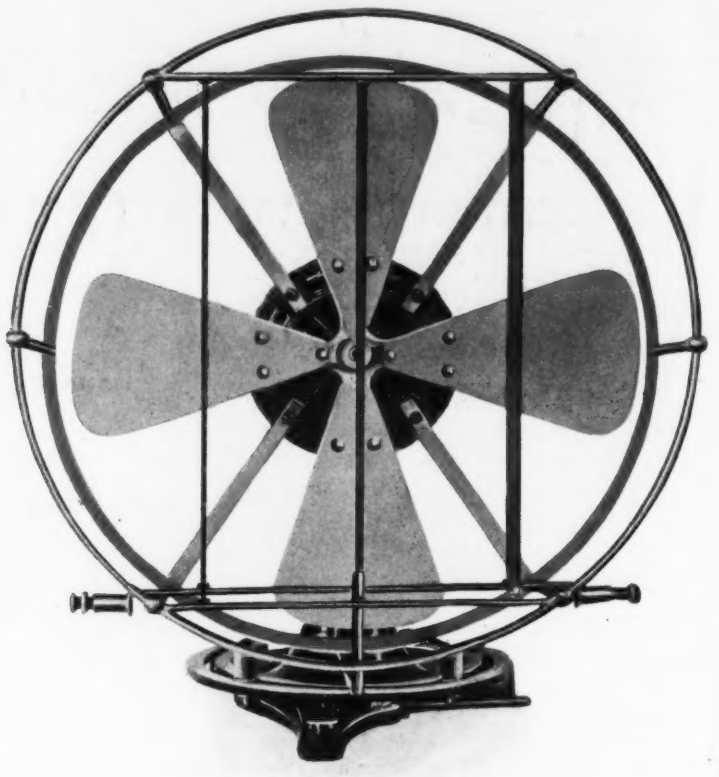


FIG. 1.—OSCILLATING FAN.

motor causes the armature to press the commutator against the brush-springs, and it would appear that a more perfect contact and flotation of the armature in the field is thus obtained. The leading-out wires from the armature are carefully protected against moisture, and against any injury, by means of a boxwood cup. The upper part of the motor field frame is removable by loosening one screw, and the entire mechanism can be examined, etc., while the fan is in full operation. This tends to the frequent inspection that adds so much to the durability of machinery, while the openness of the construction is against the accumulation of dust and dirt. Wick-feed oil cups are used.

The resistance is another interesting feature, consisting not as usual in wire, but in a composition in bar form, over which the contact moves, so that the variation of speed is not by a few jumps, but by a delicate variation of degrees up to the full amount, the maximum in this fan being, moreover, unusually high, so that users can adjust the amount of breeze most closely through all the range of summer temperatures.

Coming now to the special oscillating features of the fan motor under consideration, it will be noted at once by those who recall the earlier form that the oscillator blades have been greatly reduced in number, and that the chain has been entirely suppressed, so that even its faint rattle is no longer heard. The motor itself is buoyed up on ball bearings in the stand, and the motor as it oscillates hits softly limiting thumb-screws in the quadrant at the base, so that its range of swing can be varied from a short arc up to an almost complete circle; while its rate of oscillation or periodicity is also equally under con-

trol. The reversible fan guards have limiting stops, and these can be screwed in or out so as to give any desired angle to their inclination, and thus the fan motor turns from side to side, distributing its grateful breeze into every corner. In one instance in New York City, a restaurant that was using six ordinary fan motors, has two of these "oscillators" now doing the same work. A plan that seems quite popular is to mount the device on a stout pedestal "and let it swing."

FIG. 2.—OSCILLATING FAN.

The officers of the Shedd Company are Harry M. Shedd, president; R. J. Peterson, treasurer; Theo. A. Moolten, secretary, and T. R. Weyant, genera manager.

Central Energy Intercommunicating Telephone.

The latest type of a central energy intercommunicating telephone recently put on the market by the Haines & Noyes Company, 118-132 West Jackson Boulevard, Chicago, is made up in any kind of wood desired, and is of high piano finish. The transmitters are of its non-packing type for long-distance use. They are of heavy cast brass. The receivers are of the bi-polar pony Bell type, with water-shrunk hard-rubber shell. The cords are of green linen and have sealed connections inside the receiver. The hooks have platinum points and German silver springs, absolutely sure and positive. The jacks are heavy and of German silver. The plugs are all brass with ball tip and hard-rubber handle. The silk cord has underneath it a spiral brass piano spring which covers the copper strands and prevents breaking.

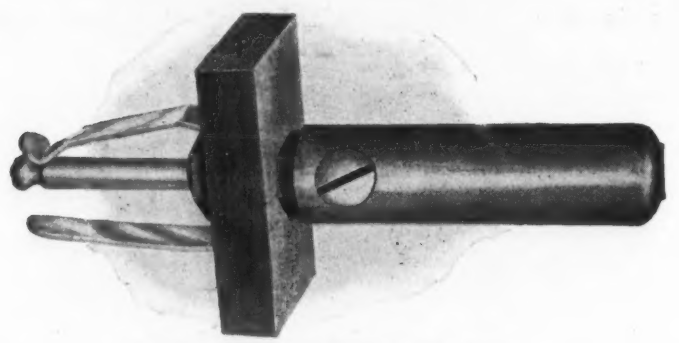


FIG. I.—TELEPHONE JACK AND PLUG.

In designing this apparatus the idea was to overcome the usual

FIG. 2.—INTERCOMMUNICATING TELEPHONE.

It is not necessary to return the plug to the home station after being used to permit the home station to be rung up by any other station. These telephones are in use throughout America and Canada.

The installation of this system is very simple. There are three more wires used than the number of stations desired, while the batteries are placed in one central place.

Flash-Light Electric Signal Telephone Switchboard.

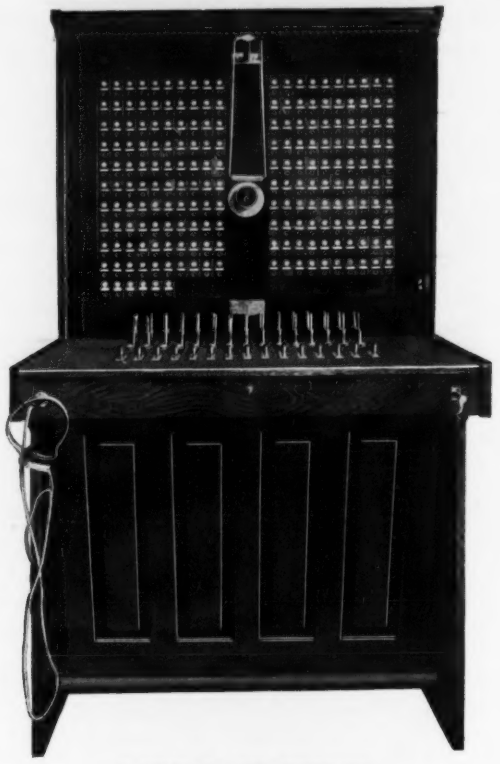
The illustration (page 243) shows a new type of electric light signal switchboard made by the Eureka Electric Co., of Chicago, which contains a number of improvements over the ordinary type of switchboards and central office equipment. The cut shows a regular 200-capacity cabinet with 200-line signals installed and 6 electric light transfer signals. Additional cabinets can be mounted by the side of this board, giving a capacity up to 1000 lines, without making any change in the original installation. The board is made for both magneto and central energy work.

The cams employed in the operator's circuit are of the lever Bell type key, and are mounted on a shelf holding the electric light clearing signals as well as the plugs and cords. A special feature is that by an ingenious arrangement a self-contained automatically cut-out relay is employed, which is also removable, for the line signal. The transfer employed is also of the self-contained automatically cut-off relay type, and operates as follows:

An operator desiring connection with another board in the system by the insertion of a plug into the jack of the transfer relay lights the light on both her board and the board with which she desires connection, the instant that the called operator answers, both lights are automatically extinguished. This simple flash light relay transfer system makes it impossible to hang up the subscriber or a pair of cords, without the signals remaining lit.

The rapidity of operation is such that one operator can easily and with comfort accommodate and handle 200 subscribers. The advantage of one operator handling this number of subscribers is quite apparent in the earning capacity of the exchange. The apparatus may be operated either from primary batteries or from regular equipped exchange having generators, dynamos and storage cells. The cabinets are all furnished in quarter-sawed oak, finished in golden oak finish. The construction of the key shelf is three-ply and hinged; the plug shelf is covered with heavy belt leather and bushed to prevent wear on the table as well as the plugs and cords.

In designing this apparatus the idea was to overcome the usual objectionable features found in boards of the flash light pattern. As all the relays are self-contained and in units, as many can be installed up to the capacity of the cabinet as may be desired by the purchaser, either at the time of purchase or at a later date. The boards are furnished for straight full metallic systems, but are readily adapted to either common return or grounded systems as well. The



TELEPHONE SWITCHBOARD.

operator's circuits are of the Eureka transmitter type, and the usual other attachments like those generally placed on its express typeboard. The cabling throughout this switchboard is done with silk and cotton-insulated wire, all joints being soldered to their respective terminals without the use of acids.

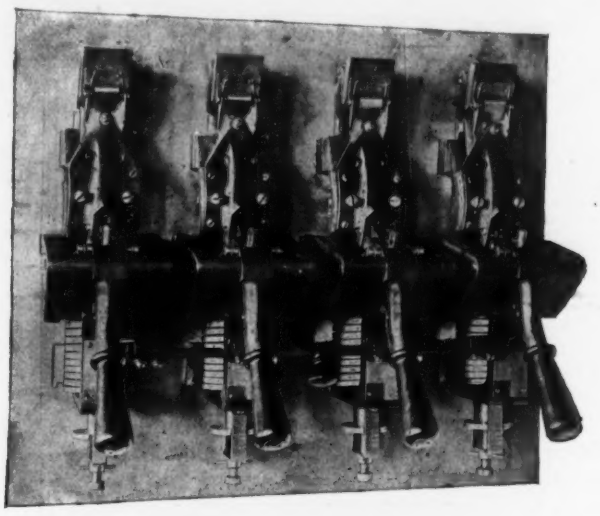
"Multiple Voltage" Circuit Breakers.

The modern practice of driving shop machines by electric motors connected directly thereto has resulted in the development of various schemes for providing these motors with a wide range of speed. One of the best known is that called the "multi-voltage system," for the protection of which the Cutter Company has brought out a circuit breaker, an illustration of which is shown in the accompanying cut. The instrument consists of four single-pole automatic circuit breakers, with the latches so connected that an excess of current passing through the operating coil of any one breaker will open the four poles at the same instant. Having independent arms, it is a combination of a switch and a circuit breaker, and renders the use of the usual hand-switch unnecessary. The tripping mechanism is provided with a small handle, so that the four poles can be released manually.

The movable switch member consists of copper laminations, and is brought by toggle mechanism into contact with flat copper terminals, which are parts of the studs. The automatic overload release is obtained by means of a plunger, which, upon the passage of excessive current, is drawn into the solenoid and strikes the latch a "hammer blow," releasing it and allowing the breaker to open. Such a circuit breaker set is placed between the "compensating transformers" and the load. The "compensating transformer" consists of either three direct-current motors, of different voltages, mounted on the same shaft, or a double commutatored motor and a single commutatored motor, mounted on the same shaft; the combined voltage of the set, in series, being equal to the voltage of the generator.

The individual machines run either as motors or generators, depending upon the manner in which the load is divided between the various circuits. The variable speed motors which such a system is designed to drive have their fields connected across the outside wires, thus receiving the maximum voltage, while the pressure at the armature terminals may be varied by shifting it from one circuit to another of the four-wire system; the constant speed motors being run the highest voltage, therefore, on the outside wires.

With such a system it is absolutely essential that in case of an overload on any one wire, the entire four wires be open at the same instant; for, assuming that a heavy load is on one circuit and a single motor on an adjacent circuit, if the wire common to the two circuits



"MULTIPLE VOLTAGE" CIRCUIT BREAKERS.

should be opened in any way, the current due to the heavy load would be sent directly through the small motor, most likely burning it out and short circuiting that circuit, which would make the remaining motors speed up, due to the increased voltage obtained from the other circuit and causing general damage.

Cable Head and Protector Terminal.

The cut herewith shows a new cable head terminal made by the Eureka Electric Company, of Chicago. This head can be used at the junction pole terminal, or as an office terminal, and is so constructed that fuse protection can be employed. The base of the head is tin, and to this the cable solders. The joint is wiped and the cable head becomes the junction terminal and part of the cable. The bridle wires are then attached and connected to the line circuit, making a compact and complete junction pole terminal head, or office terminal head.

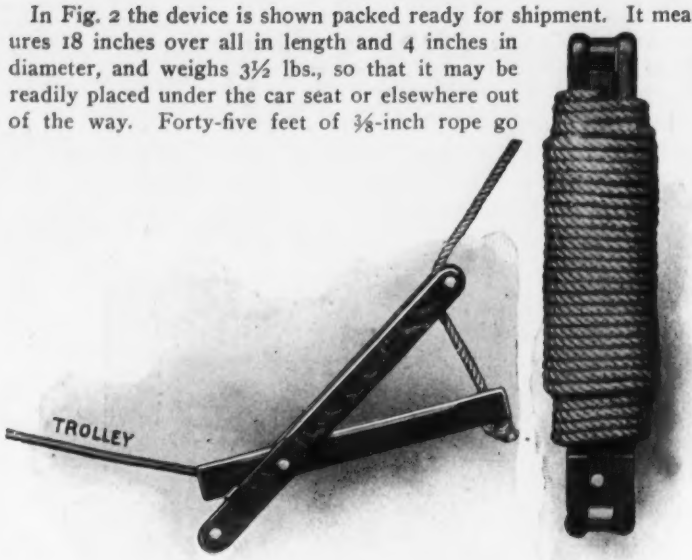
CABLE HEAD.

The general construction of the head is of steel, pressed and formed into shape, and after the cable has been attached to the head and the joints soldered and wiped, the inside of the head is filled with oxite or paraffine, thereby giving protection from moisture to the cable and protecting it against any damages. These heads are built in 26, 52 and 104-pair sizes, and will also be furnished readily in special sizes where requirements demand. In addition to giving protection to the exchange by either fuse or heat coil, as may be preferred, on the side of the heads is mounted a ground bar lightning arrester device, thus giving all the protection that can possibly be had in a cable head terminal.

Trolley "Pick-Up."

The device illustrated on next page is designed as a means of picking up a broken trolley wire and suspending it in the air temporarily, thus permitting of the operation of cars until permanent repairs are effected. The tongs are made of oak, and the rope which is attached thereto is intended to be thrown over the limb of a tree or over a guard wire or feeder, so that the broken end of the wire may be lifted above the track. With this device suspension of traffic may be avoided in the case of a break.

In Fig. 2 the device is shown packed ready for shipment. It measures 18 inches over all in length and 4 inches in diameter, and weighs 3½ lbs., so that it may be readily placed under the car seat or elsewhere out of the way. Forty-five feet of ⅜-inch rope go



FIGS. 1 AND 2.—TROLLEY "PICK-UP."

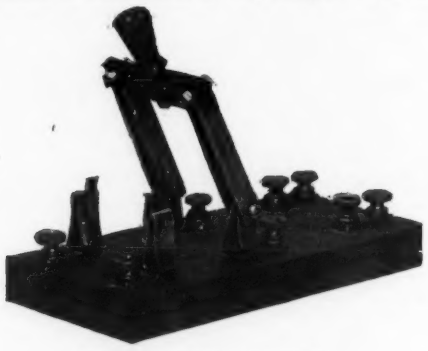
with each pick-up. This device was invented by Mr. Andrew Ambuhl, general manager of the Decatur Traction & Electric Company, Decatur, Ill., and is being manufactured by the Garton-Daniels Company, Keokuk, Iowa.

Improved Heavy Current Switches.

It has long been the practice in building circuit breakers of the automatic type to use special means for preventing the destruction of the working contacts by an auxiliary break. Such an arrangement, it is said, is really less needed on a switch which always opens quickly than on one operated by hand and liable to be opened or closed slowly.

In the new switch made by Johnson & Morton to meet these conditions the blade is made double of single pieces of pure copper, and the current-carrying contact is between the inside surfaces of the blade and a spring contact post fitting between them. The contact post also has an auxiliary contact touching on the outside of the blade, and forming the first and last point of contact when the switch is operated. By this means the arcing is all confined to a point used only for that purpose, and can in no way affect the working contacts of the switch, which by constant use are worn to a more perfect fit instead of being rapidly destroyed by the arc.

The construction of the switch is very simple. The electrical parts



HEAVY CURRENT SWITCH.

consist of three pieces in each pole, namely, a contact post, a hinged post and a blade, each one a single piece of pure hard-drawn copper. The blade is doubled on itself, and the yoke or handle bar is inlet into the front end, with a bolt attaching the two parts in the most secure manner possible. The blade straddles the contact and hinge posts, and the hinge bolt is threaded into one side of it with a jam nut to prevent any loosening or tightening from use. Both the hinge and contact posts are folded from sheet metal, and the form gives resilience at the contact surfaces with all the rigidity of a solid block. Both parts are fatsened with two screws.

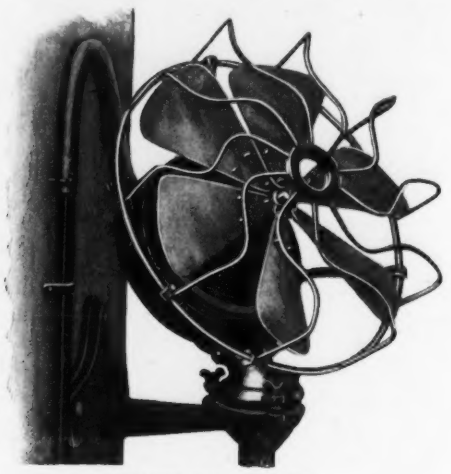
The firm anticipating the great demand for such a switch, have equipped their factory with full automatic machinery for the production of the switches and are putting them out at the price of the ordinary type.

Bracket Style of Water Fan Motor.

A ball-and-socket bracket type of water fan motor is shown herewith, the manufacture of A. Rosenberg Company, of Baltimore, Md.

This water fan is intended to be regarded as on a par with the very best makes of electric fans, and like the adjustable electric fans, can be turned and tilted in any direction while running. They are made in two sizes, 7-inch diameter and 9-inch diameter. The 7-inch type is made in two styles for fan service, as well as for driving light machinery, such as a sewing machine, ceiling fan, churn, scroll saw, etc.

The bracket style shown in the cut is supplied with 12-inch 6-blade



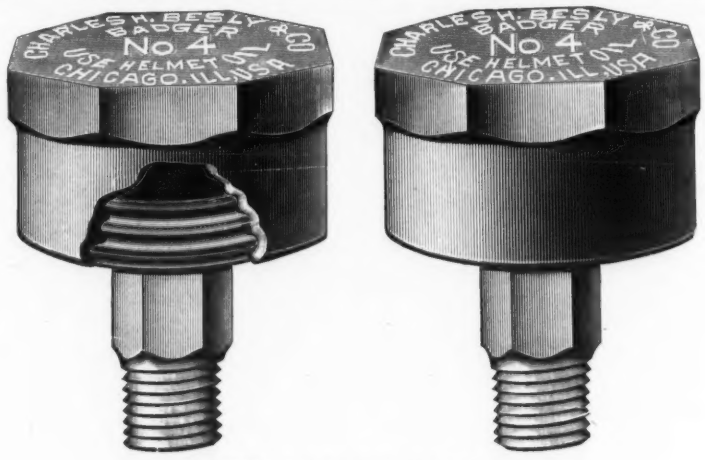
WATER FAN MOTOR.

brass fan and brass guard, and both styles will drive the fan 700 r. p. m. with a pressure at 15 lbs. in the pipes, up to 1700 r. p. m., where there is pressure of 60 lbs., the speeds varying with the pressures. No limit is placed upon the pressures which can be applied, and a great range of speeds can be had by simply turning the water cock.

These fan motors are handsomely enameled and decorated, consume very little water and are of the same power as the general type of electric 12-inch fan motors. Some of these 7-inch water motors have been in constant use for several years, running telephone exchange generators day and night.

Improved Oil Cup.

The oil cup shown herewith is being introduced by Messrs. Charles H. Besly & Co., No. 10 North Canal Street, Chicago, Ill., under the name of the Badger oil cup. The cup is to be used with Helmet oil, and is designed for general machinery having hard usage. It has an octagonal cap, which can be operated by hand or wrench. The base of the cup has a round thread with hexagon steel stem threaded, screwed into base and expanded. This steel stem



FIGS. 1 AND 2.—OIL CUP.

will not break off. The cup has a round thread both in the cap and on the base, as shown in sectional view. The thread will not strip, cross or clog.

This cup is made in six sizes, ranging from 1¼ inches, outside diameter, to 3⅝ inches, outside diameter, with pipe thread from ¼ inch to ½ inch.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on time loans was easier and offered in liberal amounts, the closing rates being 4@4½ per cent for all periods from 30 to 60 days. The stock market, though dull, showed a better tone, due partly to easier money and an expected good bank statement. There was little of importance done in connection with the industrials. Amalgamated Copper was steady, although a slight further reduction was announced in copper prices, and there was talk of the accumulation of the stock by inside interests. The United States Steel stocks were quiet and steady, and developed no new features. In the traction list Metropolitan advanced on the report of a new stock issue with "rights" by that company. There was considerable activity, the sales aggregating 219,075 shares, and the quotations ranging between 164 and 173. The closing price was 169⅝, a net gain of 5⅛ points. Brooklyn Rapid Transit was weak and inactive, closing at 65, a net loss of ¼ point. Manhattan Elevated closed at 135, a net loss of 1⅜ points on the week's trading. In the electric list General Electric was the only stock that showed a gain, the others being weak with downward tendencies. General Electric closed at 280, which was a net advance of 1 point, the sales being 1100 shares. Westinghouse Electric closed at 174, a net loss of 3 points; Western Union remains unchanged at 91 and Commercial Cable closed at 166, a gain of 6 points. Following are the closing quotations of Tuesday, Jan. 28:

NEW YORK.

	Jan. 21.	Jan. 28.		Jan. 21.	Jan. 28.
American Tel. & Cable..	90	—	General Electric.....	279½	279½
American Dist. Tel.....	38	—	General Carriage.....	1⅛	1
Brooklyn Rapid Transit.	65½	66	Hudson River Tel.....	100	100
Ches. & Pot. Telephone.	—	—	Metropolitan Street Ry..	167⅝	171¼
Commercial Cable.....	161	—	N. E. Elec. Veh. Tran...	½	½
Electric Boat.....	26	25	N. Y. Elec. Veh. Tran....	11½	12¾
Electric Boat pfd.....	48	47	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1⅛	2¼	Tel. & Tel. Co. America.	—	—
Electric Vehicle.....	2	1¾	Western Union Tel.....	90¾	91¼
Electric Vehicle pfd.....	4	4	West. E. & M. Co.....	174½	175½
			West. E. & M. Co., pfd...	172	—

BOSTON.

	Jan. 21.	Jan. 28.		Jan. 21.	Jan. 28.
Am. Tel. & Tel.....	158	158	Mexican Telephone.....	2	2
Cumberland Telephone..	—	—	New England Telephone.	139	—
Edison Elec. Illum.....	280	—	Westinghouse Elec.....	—	87⅛
Erie Telephone.....	19½	20½	Westinghouse Elec. pfd..	—	—
General Electric pfd.....	—	280			

PHILADELPHIA.

	Jan. 21.	Jan. 28.		Jan. 21.	Jan. 28.
American Railways.....	—	44½	Phila. Traction.....	97⅞	98¼
Electric Storage Battery.	60	56	Philadelphia Electric....	3⅜	3⅛
Elec. Storage Batt'y pfd.	60	56	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	5⅛	5⅞	Pa. Elec. Veh. pfd.....	—	2¼

CHICAGO.

	Jan. 21.	Jan. 28.		Jan. 21.	Jan. 28.
Central Union Telephone.	—	—	National Carbon pfd.....	83½	83
Chicago Edison.....	163	164	Northwest Elev. com....	38	35
Chicago City Ry.....	190	190	Union Traction.....	10	11¼
Chicago Telep. Co.....	—	185	Union Traction pfd...	47¼	47
National Carbon.....	18¼	18¼			

DIVIDENDS.—The Boston Edison Electric Illuminating Co. has declared a regular quarterly dividend of 2½ per cent, payable Feb. 1. The Grand Rapids Railway directors have declared a regular quarterly dividend of 1¼ per cent on the preferred stock, payable Feb. 1. The directors of the Twin City Rapid Transit Company have declared the regular semi-annual dividend of 2 per cent on the common stock, payable Feb. 15. The directors of the Minneapolis General Electric Company have declared a dividend of $3 per share on the preferred stock, payable Feb. 1. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent on the assenting stock. The Allis-Chalmers directors have declared the regular quarterly dividend of 1¾ per cent on the preferred stock. The directors of the New England Telephone Company have declared the regular quarterly dividend of $1.50 per share, payable Feb. 15. The Bell Telephone Company, of Philadelphia, has declared a dividend of 2 per cent, payable Jan. 25. The directors of the American Light & Traction Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 15. The directors of the Minneapolis General Electric Company have declared a dividend of $3 per share on the preferred stock, payable Feb. 1.

A. D. T. ANNUAL MEETING.—At the annual meeting of the American District Telegraph Company last week the old officers of the company, Thomas T. Eckert, president; C. A. Tinker, vice-president, and C. S. Shivler, secretary and treasurer, were re-elected. There was no contest, differences between opposing interests in the company having been compromised before the meeting was held. C. A. Missing was elected a director, in the place of the late Marcellus Hartley, and W. H. Taylor, instead of E. Bartow Hepburn. This leaves the Western Union interests still in control. General Eckert's annual report to the company shows that the total income for the year was $630,701.68; the total expenses, $527,282.02, leaving a total net revenue of $103,419.66, which, with a cash surplus on Dec. 31, 1900, of $80,503.65, leaves a total surplus of $183,923.31. The company paid dividends during the year 1901 of $96,107.50, leaving a net surplus on Dec. 31, 1901, of $87,815.81. It is understood the proposition to reduce capitalization from $4,000,000 to $2,000,000 will not be carried. The Western Union Messenger Company, incorporated at Trenton, N. J., with a capital of $500,000, is not likely now to do business.

WESTERN TELEPHONE COMPANIES.—The Western Telephone & Telegraph Company, with an allowed capital of $32,000,000, and the Occidental Telephone & Telegraph Company, with a capital of $5,000,000, have been incorporated at Trenton, N. J. The first was incorporated by Chandler Hovey, George E. Perrin and Albert T. Walker, of Guttenberg, N. J., and Elmer H. Geran, of Matawan, N. J., and the Occidental Company by the same persons, together with Russell Robb, Horace Rogers and Henry R. Hazen, all of Boston. The capital of the Western company is to be divided into $16,000,000 of preferred stock, calling for 6 per cent non-cumulative dividend until February, 1904, and then become cumulative, and $16,000,000 of common stock. Both companies are chartered under the act of 1896, thus authorizing their operation outside of New Jersey.

BELL TELEPHONE BONDS.—Kidder, Peabody & Co., of Boston, and Vermilye & Co., of New York, are offering at 99 and accrued interest $10,000,000 of 4 per cent bonds of the American Telephone & Telegraph Company, part of an issue of $13,000,000, the other $3,000,000 having been sold already. The money is to pay for the Western Telephone & Telegraph Company—or Erie system—just acquired, and whose treasury has had $6,000,000 just paid into it for needed extensions and improvements. President Fish shows the net Bell telephone revenue for 1901 to have been about $8,000,000. The present $38,000,000 of bonds take $1,520,000, leaving $6,800,000 at present applicable on stock.

THE STAR TELEPHONE COMPANY has been incorporated at Albany, N. Y., with a capital stock of $1,000,000. The incorporators were Axel W. Hallenborg, Alfred B. Cruikshank, Erskine B. Essig, Sheron S. Atwater and Frederick Koch, of New York; Frank W. Goreth, of East Orange, N. J., and C. Edward Blackman, of Brooklyn. Mr. Hallenborg said that the company would not disclose its plans for some time yet. Its charter permits it to maintain telephone and telegraph lines from New York to Albany, Boston and intermediate cities; also upon Long Island and from Jersey City to Philadelphia.

NEW ENGLAND ELECTRIC VEHICLE.—The New England Electric Vehicle Transportation Company has disposed of all of its vehicles, and now has $145,000 cash on hand besides its real estate. It is anticipated that when the company disposes of its real estate assets (assessed for $204,000) it will be able to divide between $1 and $1.50 per share in liquidation among its stockholders. The first dividend in liquidation amounted to $2.50 per share on 225,000 shares. The company has succeeded in settling practically all the lawsuits against it, the remaining unsettled suits being fully covered by insurance.

FRENCH SECURITIES.—Some of the year's declines in French securities are thus summarized by the *London Economist's* Paris correspondent: Paris Omnibus shares fell from 1,402 francs per share to 703; Metropolitan Underground, from 600 to 567; East Parisian Tramways, from 410 to 115; Thomson-Houston, 1,265 to 703; Paris Gas Company, 1,350 to 825; Rio Tinto mining shares, 1,440 to 1,015; Cape Copper from 140 to 116.

THE SEATTLE ELECTRIC COMPANY will hold a special meeting at Seattle, Wash., Feb. 21, to increase the capital stock from $6,750,000 to $8,000,000, such increase to consist of $1,250,000 of preferred stock. The stock transfer books will be closed from Feb. 7 to Feb. 21, inclusive.

UTICA TROLLEYS.—At a meeting of the stockholders of the Utica & Mohawk Valley Electric Railroad, New York State, it was voted to increase the capital stock from $461,237 to $3,100,000, of which $600,000 is preferred stock.

PHILADELPHIA BELL TELEPHONE.—There has been listed on the Stock Exchange $999,350 additional stock of the Bell Telephone Company, of Philadelphia.

MONTREAL ELECTRICAL FINANCES.—At a meeting of the shareholders of the Montreal Light, Heat & Power Company on Jan. 14 the directors were authorized to issue bonds of the company to the extent of $7,500,000 for the purpose of reorganizing the bonded indebtedness of the various companies that have been amalgamated into the big electric concern. The issue will be distributed as follows: Bonds of the Chambly Company, $2,000,000; general purposes, $500,000; bonds of the Gas Company, $880,000; bonds of the Royal Electric Company, $525,000; to be borrowed from time to time as may be necessary for purposes of construction, etc., $3,595,000. The new sub-station of the company will be ready for operation in May next, and it is stated will be the finest and best equipped building of its kind on the continent. When all the alterations are completed, the company will have a total steam horse-power of about 6000, in addition to the 20,000 hp from Chambly. The Montreal Company has just sold $2,500,000 4½ per cent bonds to N. W. Harris & Co. This company has $17,000,000 capital stock outstanding. It controls the public lighting of the city of Montreal, both by gas and electricity, and furnishes gas and electricity for domestic and commercial use, for illuminating, heating and power. It also supplies the Montreal Street Railway with power. The Heat & Power Company owns a large water-power plant for the development of electricity at Chambly, on the Richelieu River, the outlet of Lake Champlain. The power generated at this plant is transmitted 18 miles to the city of Montreal. In the past Canadian financiers have placed their large loans in London, but under present financial conditions they are coming to the leading banking houses of the United States.

ALLIS-CHALMERS.—Judge Elbert H. Gary, chairman of the board of directors of the United States Steel Corporation, has been elected chairman of the board of directors of the Allis-Chalmers Company, capitalized at $25,000,000. Wm. Allis retires with Edwin Reynolds. William J. Chalmers, of Chicago, is chairman of the executive committee of the company. It is not known whether ex-Judge Gary's accession to the corporation will relieve Mr. Chalmers of some of his duties, but it is supposed the new chairman's work will be largely on the financial side, leaving the operating of the factories in the hands of Mr. Chalmers. Mr. Gary has been a leading official of the gradually expanding Steel Corporation since it began to take form. He was one of the organizers of the American Steel & Wire Company. Later he became president of the $200,000,000 Federal Steel Company, and last year he was chosen chairman of the board of the United States Steel Corporation.

ANGLO-AMERICAN CABLE.—A holder of Anglo-Cable stock says: "If Marconi's wireless telegraphy were to render the Anglo-American cables absolutely valueless, thus making it necessary to wind up the company, according to the last balance sheet, there would be nearly £1,000,000 surplus (mainly derived from the splendid reserve fund, which is invested in gilt-edged securities outside the business) in which the deferred shareholders would participate equally with the preferred. This would make the value of the deferred nearly 14, which are now quoted at little more than 8. If such would be the position in the event of winding up, how much should the stock be worth in a going concern?"

SECURITY CONDUIT.—The New York Sheriff has received an attachment and two executions, aggregating $1,491, against the Security Conduit Company, of 585 Washington Street. The attachment is in favor of Francis B. Boynton, for $700, for money loaned to the company, and the executions are in favor of John Hankin, $435 on a note, and Woodbury G. Langdon, $356 for money loaned. The company was incorporated March 4, 1901, under New Jersey laws, with a capital stock of $250,000. Charles A. Boynton was president and Robert H. McCutcheon treasurer.

TERMINUS FOR TROLLEY TUNNEL.—It is the general impression among New York real estate men that the block bounded by Fourteenth, Provost, Thirteenth and Henderson streets, Jersey City, which has been sold to Rollin C. Newton, will be used as a terminal station for the proposed trolley tunnel under the Hudson River to Morton Street, New York. Surveys of the block have recently been made by civil engineers said to have been employed by the Metropolitan Street Railway Company, of New York. The price paid for the property was $60,000.

NEW YORK TRANSPORTATION.—It is stated that the Electric Vehicle Company last week paid an assessment of over $500,000 on its holdings of New York Transportation stock. This was the only outstanding block of New York Transportation on which the recent assessment of $10 a share remained unpaid.

SYRACUSE, N. Y., BONDS.—Redmond, Kerr & Co., of New York are offering $2,000,000 first mortgage 5 per cent gold bonds of the Syracuse Lighting Company at 102½ and accrued interest. The company has $1,000,000 of 5 per cent preferred stock, and $3,000,000 of common stock.

DEVELOPMENT IN PORTO RICO.—Stone & Webster, Lee, Higginson & Co. and De Ford & Co., of Boston, have organized the Ponce Electric Company to do a street railway, lighting and power business in Porto Rico, with a capital of $415,000.

AMERICAN CRANE & CONVEYING COMPANY is the name of a new proposed consolidation which will, if it goes through, include concerns now building electric cranes.

Commercial Intelligence.

THE WEEK IN TRADE.—The general trade conditions remained favorable, the most notable of these being the steadiness of general prices. Iron and steel continue strong, though on the surface there is apparently a quieter demand, and the improvement in the car shortage situation makes a larger production. There is more doing than usual at this time, and the mills have never had so many advance orders booked. The demand for structural material all over the country continues exceedingly heavy. The bids on the New York Rapid Transit power house were opened on Jan. 23, and will receive immediate consideration. In other metals irregularity is still a feature, weakness being manifested in copper, which failed to develop consumptive demand, although quotations for it have again declined and sheet copper has likewise been reduced. The price quoted on the New York Metal Exchange at the close of the week is 11 cents flat. Electrolytic is quoted at 10⅞ cents, and casting stock at 10¾. Railway earnings continue in a very satisfactory condition. For the first half of January, 51 roads reported an increase of 10.8 per cent in gross earnings over the figures for the same period last year. Eight of the 51 roads show losses from last year. The business failures for the week, as reported by *Bradstreet's*, numbered 292 against 291 the week previous, and 281 the same week last year.

REPRESENTATION OF FOREIGN INTERESTS.—The Goudey-McLean Company, of 88 Maiden Lane, New York City, recently established with a view to acting as managers for foreign sales of a syndicate of manufacturers of electrical apparatus and fittings, in addition to the agreement with various electrical concerns to whom reference was lately made in these columns, has entered into arrangements with the New York Safety Insulated Wire Company for the purpose of the exclusive handling of that company's export business in all foreign countries other than Mexico. A contract has also been made with the Garton-Daniels Company, of Koekuk, Iowa, for the representation of that concern's interests abroad. Mr. Edward E. Goudey, who was formerly manager of the foreign department of the Wagner Electric Manufacturing Company, of St. Louis, Mo., is secretary of the Goudey-McLean Company. He is now in Europe for the purpose of appointing agents in the principal electrical centers in Great Britain and on the Continent, and will remain on the other side, according to present arrangements, until May. Offices have already been opened in London and Glasgow, and negotiations are about completed for the establishment of a Paris agency. The London business of the company will be under the management of Mr. A. Woodley, lately connected in an executive capacity with the Edison-Swan Company. Offices have been taken at 90 Cannon Street, E. C. The Glasgow office is under the supervision of Mr. James Barclay. The company proposes to make a specialty of furnishing complete plants. An 18-hp lighting outfit has recently been ordered for shipment to a coffee plantation located in the vicinity of Port Limon, Costa Rica. The dynamo was manufactured by the Milwaukee Electric Company. Several direct-current Milwaukee motors have also been ordered for Cuba. A complete telephone exchange has just been shiped to Berlin, and several lightning arresters, made by the Garton-Daniels Company, have gone forward for Belgian parties. Inquiries now on hand include a complete telephone equipment for 600 subscribers, for Japan, and a 4000-hp vertical triple-expansion condensing engine intended for lighting purposes in Glasgow

INDUCTION MOTORS FOR COMSTOCK MINES.—A contract has been closed by Leon M. Hall, consulting electrical engineer for the Comstock Pumping Association, for three 225-hp Westinghouse three-phase induction motors, which will be used to operate the new pumps for draining the C & C shaft. These pumps will be operated by current from the Truckee River General Electric Company's transmission plant at 2300 volts. The motors will make 495 r. p. m. The drainage water will be pumped from the 2100-ft. level to the Sutro Tunnel, 450 ft. above. The estimated capacity is 6,500,000 gallons per day. The hydraulic elevator now in use requires 850 hp to keep the water down to its present level. One hundred thousand dollars' worth of Westinghouse and General Electric motors are operated in the Comstock Mines.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Jan. 22: Amsterdam—3 pkgs. machinery, $60. Argentine Republic—82 pkgs. material, $5,336. Auxerre—6 pkgs. machinery, $165. Brazil—162 pkgs. material, $5,473; 4 pkgs. machinery, $332. Berlin—4 pkgs. material, $175. Balboa—2 pkgs. material, $175. British Possessions in Africa—382 pkgs. material, $31,637; 47 pkgs. machinery, $2,645. British West Indies—47 pkgs. material, $1,087; 3 pkgs. machinery, $101. British Guiana—25 pkgs. material, $2,350. British East Indies—19 pkgs. machinery, $442; 18 pkgs. wire rope, $1,350; 1 pkg. material, $81. Bordeaux—1 pkg. material, $29. Bristol—19 pkgs. machinery, $2,905. British Australia—84 pkgs. machinery, $7,779. Cuba—95 pkgs. material, $5,097; 105 pkgs. material, $2,917; 3 pkgs. manufactures of copper, $97; 9 pkgs. machinery, $1,600. Central America—47 pkgs. machinery, $584. Dutch East Indies—1 pkg. material, $16. Dublin—6 pkgs. material, $400. Ecuador—8 pkgs. material, $153. Fieume—67,500 lbs. copper, $8,184. French West Indies—1 pkg. material, $45. Genoa—675 pkgs. manufactures of copper, $200. Glasgow—7 pkgs. material, $701; 9 pkgs. machinery, $697; 37 pkgs. electric cables, $14,927. Havre—10 pkgs. material, $538. Hamburg—4 pkgs. machinery, $85; 61 pkgs. material, $2,664. Huddersfield—9 pkgs. material, $250. Hayti—7 pkgs. material, $117. Leeds—6 pkgs. machinery, $500; 8 pkgs. material, $446. Liverpool—473 pkgs. copper material, $26,000; 116 pkgs. wire, $1,844. London—242 pkgs. machinery, $16,132; 120 pkgs. material, $6,394; 92,500 lbs. copper, $14,288; 11 pkgs. electric cables, $2,469; 4 pkgs. manufactures of copper, $280; 24 pkgs. wire, $288. Mexico—4 pkgs. machinery, $154. Manchester—155 pkgs. machinery, $45,124; 10 pkgs. material, $250; 3 pkgs. material, $65. Marseilles—3 pkgs. material, $182. New Foundland—1 pkg. material, $30. Newcastle—12 pkgs. machinery, $1,364. Portugal Possessions in Africa—2 pkgs. material, $21. Peru—116 pkgs. copper wire, $2,050; 11 pkgs. material, $341. Reval—10 pkgs. machinery, $1,628; 336,557 lbs. copper, $42,699. Rotterdam—1,188,985 lbs. copper, $141,640; 3 pkgs. material, $60. Southampton—9 pkgs. material, $269; 15 pkgs. machinery, $723; 3 pkgs. wire, $266. Stockholm—67,234 lbs. copper, $8,746. San Domingo—13 pkgs. machinery, $217; 2 pkgs. manufactures of copper, $63; 5 pkgs. copper wire, $140. U. S. Colombia—2 pkgs. manufactures of copper, $30. Venezuela—166 pkgs. material, $579; 428 lbs. copper, $17. Walsall—4 pkgs. material, $180.

LARGE POWER PLANT FOR ST. LOUIS.—The contract for the foundation of the largest electric plant west of New York was let Jan. 25 by the Citizens' Electric Light & Power Company, of St. Louis, to the Hill-O'Meara Construction Company, of that city, for $300,000 for the foundation alone. The entire plant will cost $2,000,000. The plant will be erected at the foot of Biddle Street. It will extend well into the river in order that the company may get its water supply without using the city mains. The building will have a water front of 500 ft., and will extend back 200 ft. from the river. The contracts call for the completion of the foundations within 120 days. The main river wall of the foundation is to be 11 ft. thick and 60 ft. high, constructed of steel buttresses 6 ft. apart, and incased in concrete, the base having buffers of oak to protect the coal boats which will be moored alongside. Above this foundation the building will rise 60 ft. Charles H. Ledlie, the engineer who has drawn the plans for the plant, has already contracted for the 26 boilers, which will be used, and the four engines, three of 700 hp each and two of 2500 hp each. According to his plans all the transportation of materials for the building and for its future maintenance will be by water to save expense. The coal will be dumped in gravity bins and fed automatically. The average production of the plant will be 20,000 hp.

ROWLAND TELEGRAPH FOR ITALY.—The multiplex printing telegraph system invented by the late Professor Rowland, of Johns Hopkins University, will be installed in Italy. The Rowland Telegraphic Company, of Baltimore, has been awarded a contract by the Italian Government to equip a line between Rome and Naples, and if it is satisfactory other Italian lines of telegraph are to be supplied with this system. Considerable interest has been manifested by European governments in this system. The company is manufacturing machines for the use of the German Government between Berlin and Hamburg and Berlin and Frankfort. Louis De Goll, president of the company, has been in Europe for some time in connection with the installation of the system. It will be recalled that eight messages can be sent at one time over one wire, four going in one direction and four in the other. Typewritten copies of these messages are made at both the points of sending and receiving by the action of the machine. One operator can also send the same message over four different wires to four different cities. This arrangement can be quadruplexed, so that 16 cities or points of delivery can be reached. The system was shown in operation at the Paris Exposition of 1900.

WESTINGHOUSE CHANGES.—The retirement of B. H. Warren from the second vice-presidency of the Westinghouse Electric & Mfg. Co. has brought about the following changes in the organization of that concern: Mr. Frank H. Taylor, until recently fourth vice-president, has been advanced to the position of second vice-president, and as such will be in charge of the sales of the company and have a general supervision over its affairs. Mr. L. A. Osborne, manager of works, has been made fourth vice-president, in which capacity he will have charge of the engineering and producing operations of the company. Mr. Arthur Hartwell has been advanced to the position of sales manager in charge of the sales organization. Mr. Hartwell has until recently occupied the position of manager of the Chicago office of the company. Mr. Philip A. Lange, until recently general superintendent, has been made manager of works, in which position he will have charge of the manufacturing department of the company. The organization in other respects remains as heretofore. Mr. George Westinghouse, president; Mr. Ph. Ferd. Kobbe, third vice-president and treasurer, in charge of financial department; Messrs. G. W. Hebard and W. M. McFarland, acting vice-presidents; Mr. T. W. Siemon, assistant treasurer; Mr. A. M. Mattice, chief engineer; Mr. Charles F. Scott, chief electrician; Mr. B. G. Lamme, assistant chief engineer; Mr. James C. Bennett, auditor.

THE STEAM LOOP ABROAD.—The Steam Loop and Holly gravity return system are receiving flattering recognition, particularly at the hands of English engineers, and as a result Westinghouse, Church, Kerr & Co. have received several excellent contracts lately for equipments of this kind. One of the latest is from a large manufacturing concern which is one of the most important establishments in the British Isles. It is claimed that this plant will have the finest equipment for manufacturing in Great Britain, and that every department will represent the highest development of modern engineering. Consequently, the decision to introduce the steam loop and Holly gravity return system is very gratifying to Westinghouse, Church, Kerr & Co. Another contract reported by the export department of the company is for an equipment for La Gran Fundicion Central Mexicana, Aguas Calientes, Mex., placed by the American Smelting & Refining Company. The system has also been adopted for the Albany (N. Y.) Felt Company, the Waterloo (Iowa) Gas & Electric Company, and Everett (Wash.) Railway & Electric Company.

GERMAN EQUIPMENT FOR JAPANESE COLLIERIES.—The contract for the electrical equipment, which is intended to be installed in the collieries operated by the Hokkardo-Tanko Railway, Japan, has been awarded to the Siemens-Halske Company, of Berlin, the German firm's prices being 13 per cent lower than the best bids secured from American sources. The principal items in the contract, which is valued at nearly $70,000, are two 300-kw generators and the same number of direct-connected engines of 350 hp capacity each. The contract for the boilers has been placed with an American firm—the Heine Safety Boiler Company, of St. Louis, Mo., whose New York offices are in the Bowling Green Building. There will be four boilers, capable of developing 200 hp each.

FOREIGN CONTRACTS.—The municipality of Ghent, Belgium, is inviting tenders for a concession of 31 years with a monopoly during the first 15 years, for the erection and maintenance of an electricity supply station and service. Further particulars may be obtained by addressing L'Ingenieur de la Ville, 3 rue Royale, Ghent, Belgium. The Town Council of Johannesberg, South Africa, is inviting tenders for the supply of a three-phase alternator of 250-kw capacity. The contract closes Feb. 28, and tenders should be addressed to Lionel Curtis, acting town clerk. The municipality of Rockhampton, Queensland, is inviting bids for the construction of a complete electric railway system. The contract closes March 31. Particulars may be obtained of H. E. Bellamy, city engineer.

RATING OF RUSSIAN FIRMS.—Under date of Dec. 20, 1901, Consul-General Holloway, of St. Petersburg, says: One of the greatest hindrances to American business in Russia has been the difficulty in ascertaining the financial standing of firms soliciting credit, as commercial or inquiry agencies are unknown in this country. The usual way of prosecuting such inquiries is through special attorneys, who investigate and report on each case separately, charging according to the time occupied, viz., from 10 to 100 rubles ($5.15 to $51.50). I am now advised that The Bradstreet Company, through its New York or Berlin agencies, is prepared to report on the financial standing of Russian business men, corporations and firms.

SYDNEY POWER HOUSE CONTRACT.—The American Bridge Company, of New York, has been awarded the contract for the furnishing of the structural steel to be utilized in the extension which is about to be made to the central generating station of the Sydney City & Suburban Tramways, New South Wales, the same company having secured the contract for the original station, which is built with some 1200 tons of steel ,and is the first metal construction building in Australia. The present contract calls for 700 tons of material. Delivery is to be made inside of four months.

WESTERN ELECTRIC-BALL PLANT.—The M. A. Meyer estate, Chicago, are installing an electric plant in their building at southwest corner of Van Bureau and Franklin streets. The Ball Engine Company, Erie, Pa., furnish the engine, which is direct connected to a 100-kw Western Electric generator.

WESTINGHOUSE ENGINES FOR SWEDEN.—Graham Brothers, of Stockholm, which concern represents the Swedish interests of a number of American manufacturers, and is the largest handler of American electrical equipment in that part of the world, has placed a contract with Westinghouse, Church, Kerr & Co., calling for the supply of two vertical cross-compound engines of 250 hp capacity each. These machines will be direct connected to generators of German manufacture. The equipment will be installed in a new electric light and power plant, now under construction in the Swedish capital. Some of the other recent contracts secured by Westinghouse, Church, Kerr & Co. comprise two 330-hp vertical cross-compound engines, also one 150-hp engine for installation in the new Omaha shops of the Union Pacific Railway Company. These engines will be direct connected to Westinghouse generators. Several motors have also been ordered from the Westinghouse people for the same shops. The equipment is intended to be used for both light and power purposes. The Boston & Albany Railroad is to be furnished with a 330-hp vertical cross compound engine to be direct connected to a Westinghouse generator. This outfit will be for lighting use. Two vertical cross-compound engines of 200-hp capacity and also a 150-hp engine, both to be direct connected to Westinghouse generators, are to be furnished for light and power purposes to the Pittsburg Bank of Savings Building. The Minneapolis Chamber of Commerce Building is to be installed with two 150-hp vertical cross-compound engines, also a 100-hp machine direct connected to Westinghouse generators for both light and power, and the Orr Cotton Mills, of Anderson, N. C., have ordered a 21½ by 37 by 22 steeple compound engine. This machine will be capable of developing over 1200 hp.

ELECTRICAL EQUIPMENT FOR BOMBAY HOTEL.—The big hotel which is now under construction at Bombay, India, by Mr. J. N. Tata, a wealthy Parsee merchant and principal partner of Tata & Co., of 27 William Street, New York, is to be equipped with electrical machinery, etc., which it is estimated will entail an expenditure of nearly $100,000. The hotel, it is said, will cost $600,000 without furnishings, and will be the largest and most modern establishment of its description in the Far East. It will be five stories in height. There will be 400 rooms. An interesting feature will be that 20 suites of rooms fronting the sea are to be cooled by artificial refrigeration, the machinery for the supply of which will be operated by electricity. It is said that this will be the first instance of an hotel adopting this plan to make its rooms comfortable in hot weather. The specifications call for four engines, to run at 460 r. p. m., of 75 hp each, at 140 lbs. pressure, and four dynamos, to be wound for 110 volts and 365 amperes, at 460 revolutions. There will be three electric elevators. The refrigerator motors are to be shunt wound, two in number. They are required to work at a potential of 100 volts, and to develop each 40 hp. There are to be about 1200 lights of various sizes. American concerns are expected to furnish the electric light plant, the refrigerating machinery, the insulated wires, etc., elevators and telephones.

TELEPHONE CONTRACTS.—During the past two months the Haines & Noyes Company, Chicago, U. S. A., have closed the following large contracts for telephone apparatus: The Manistee Iron Works, Manistee, Mich.; Story & Clark Piano Company, Grand Haven, Mich.; David C. Cook Publishing Company, Elgin, Ill.; Rush Medical College, Chicago; Evanston Hospital, Evanston, Ill.; St. Anne's Hospital, Chicago; Chas. F. Elmes Engineering Works, Chicago; Armour & Co., Chicago; Chicago & Eastern Illinois Railroad, Chicago; Ingersoll-Sargeant Drill Company, Chicago; Otis Apartment Building, Chicago; Hamilton Apartment Building, Chicago. They have also equipped the following electric railways with telephone apparatus: Tampa Electric Street Railway Company, Tampa, Fla.; Houghton County Street Railway Company, Hancock, Mich.; Blue Hill Street Railway Company, Milton, Mass.; Ponce Railway & Light Company, Porto Rico.

AN EXPORT CLUB FOR NEW YORK.—A movement is at present on foot for the purpose of establishing an export club in New York, and negotiations are being conducted with a view to the acquiring of spacious premises downtown, which will serve as a central point of reunion, where the individual buyers of the New York export and commission houses can meet socially the representatives of manufacturing concerns. It is proposed to adopt the most complete up-to-date system of cabinet filing of catalogues, price lists and discounts which it is suggested will make it preferable for the buyers to come to the rooms of the club for information and reference. The temporary offices of the club are located in the Coffee Exchange Building, 66 Beaver Street.

LARGE WATER POWER PROJECT FOR BOMBAY.—Mr. J. N. Tata, of Bombay, the head of the Indian house of Tata & Co., whose New York offices are located in the Lord's Court Building, 27 William Street, is reported to be primarily interested in a project for the erection of an extensive water power plant to be situated at Neral, about 40 miles distant from Bombay. It is proposed to generate electricity for the purpose of supplying general power to various manufacturing establishments in Bombay, and to furnish current for the operation of the electric traction system, which is about to supplant the existing horse tramways in that Indian city.

TELEPHONES FOR HONOLULU.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., report that they have recently shipped to their agent, Mr. Guy Owens, of Honolulu, Sandwich Islands, a 24-point switchboard complete for the new Hackfield & Co. office building there; two 6-point plants complete for the office and shops of the Honolulu Iron Works; one 4-point board complete for the Oahu Railway & Land Company, and one 24-point board for plantation work. Among domestic orders they note shipment of a 12-point system to the Newcastle (Pa.) Steel Works.

LORAIN RAILS FOR NEW ZEALAND.—The Lorain Steel Company, of Lorain, Ohio, will make shipment, per Norton & Son's steamship "Oakley," of 1200 tons of steel rails, together with 50 tons of special work, intended to be used in the construction of the Auckland Electric Tramways Company, Limited, of Auckland, New Zealand. This system is controlled by the British Electric Traction Company, Limited, of London. The contract for the building of the road has been undertaken by the electrical engineering and contracting firm of J. G. White & Co.

VAN RENSSELAER LANSINGH & CO., of Chicago, agents for holophane glass and pagoda reflectors, have recently moved from a suite of offices in the Fisher Building to a store at 18 East Adams Street, where there is a better opportunity to make a public display of these goods. A contract has been closed for putting holophane globes on the lamps in the corridors of the Old Colony Building, securing better illumination while reducing the number of 16-cp lamps in each corridor from 10 to 5, thereby effecting a calculated saving of $300 per year.

NEW YORK CITY.—The New York Telephone Company has established a central office at Briarcliff Manor, the country place of Mr. W. W. Law, of New York City. One hundred and twenty long-distance telephones have been installed, connecting the barns, dairy houses, residences and a summer hotel. This is probably the only community in the world where the number of telephones is greater than the population.

W. H. SCHOTT, formerly manager of various electric lighting interests in Chicago, is now conducting a prosperous engineering and contracting business with office at 1220 Marquette Building, Chicago. Mr. Schott has recently put in steam heating plants at Bedford, Ind.; Bloomington, Ind., and Coshocton, Ohio; gas plants at Franklin, Ind., and Bedford, Ind., and the mechanical and heating equipments of the Century Building, Indianapolis, and the Illinois Asylum for the Insane at Peoria, Ill.

EQUIPMENT FOR ENGLISH LIGHT RAILWAY.—To the Cheltenham & District Light Railway Company, England, the contract for the construction of whose road Thos. Nevins & Son, of East Orange, N. J., are primarily interested in, is being shipped considerable Westinghouse equipment. The order for the cars was secured by the John Stephenson Car Company, of Elizabeth, N. J.

VICTOR TURBINES FOR BRAZIL.—W. H. Crossman & Co., of 77 Broad Street, New York City, have placed an order with the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, through the New York office, for two Victor turbine waterwheels capable of developing 500 hp. The outfit is intended to be installed in Santos, Brazil.

STANDARD TRACTION BRAKE COMPANY report an order from the Amsterdam (N. Y.) Street Railway Co. for the equipment of all their cars with magnetic brakes. The city is very hilly, accidents have happened with runaway cars, and tests have shown that the magnetic brake is just what is required to ensure safety.

DRY BATTERIES FOR LONDON.—The Chloride of Silver Dry Cell Battery Company, of Brooklyn, is shipping its specialties to John L. Sardy, of Saracen Chambers, Snow Hill, London, E. C., who is one of the half-dozen more prominent handlers of American apparatus and machinery, etc., in Great Britain.

THE GENERAL ELECTRIC COMPANY has just received the award of a large power plant contract for the fine new Readville, Mass., shops of the New York, New Haven & Hartford Railroad, not far from Boston. This plant will include a lot of motors and be one of the very best of its kind.

WESTINGHOUSE-PARSONS TURBO-GENERATORS.—The B. F. Goodrich Company, of Akron, Ohio, has requisitioned for the supply of two Westinghouse-Parsons turbo-generators of 750 and 400 kw, respectively. These machines are intended to be utilized for general power purposes.

BRILL CARS FOR WESTERN AUSTRALIA.—The J. G. Brill Company, of Philadelphia, Pa., will next week forward 25 trolley cars they have built to Freemantle, Western Australia, for use on the Kalgoorlie Electric Tramways Company, Limited—an English concern.

Special Correspondence.

ENGLISH NOTES.

LONDON OFFICE, ELECTRICAL WORLD AND ENGINEER, Jan. 20, 1902.

MERSEY RAILWAY COMPANY.—The Mersey Railway Company, whose system is being converted from steam to electricity by the British Westinghouse Company, has ordered from George F. Milner & Company, of Hadley, fifty-seven cars of a new and interesting type suitable for its underground work. The same firm are making 125 cars for the Hampton Court section of the London United Tramways Company, and a large number of cars for various corporations. The British Westinghouse Company has been awarded the contract for electric cars required by the Lancaster Town Council in connection with the local tramways. The value of the contract is £3,633.

INCANDESCENT LAMPS.—The Edison & Swan United Electric Light Company, Limited, have received the honor of appointment by royal warrant as purveyors of electric lamps to his Majesty the King.

PARIS UNDERGROUND.—The new proposed underground line in Paris has now been settled upon, and the Paris Municipal Council has formally adopted in its main lines the committee's recommendation to grant a concession for a new "tube" railway running between Montmartre at the north end of the city, and Montparnasse at the south end. The company offers to pay to the municipality a tax or due of 1 centime per passenger carried over its line up to 30,000,000 passengers, and 2 centimes per passenger for any number over 30,000,000. This is for second-class passengers; for first-class passengers the due will be 2½ centimes. The concesssionaire company is also to provide not less than $100,000, nor more than $400,000, toward the completion of the new Boulevard Raspail. The new line is to be sunk at a much greater depth than the Metropolitan electric lines now in course of construction or already running; the tunneling will be at a depth from 24 feet to 115 feet beneath the street surface. Contrary to what has happened in the case of the Metropolitan line, the new company is to carry out the entire work at its own expense, and is to undertake to link up with existing lines at certain points. The work is to be carried out without any necessity arising to take up the roadway. The concessionaires are Messrs. Berlier and Janicot, engineers and contractors. The Omnium Lyonnais, one of the most important electric traction concerns in France, is financing the scheme.

LARGE ENGINES.—The engines which the Wallsend Slipway & Engineering Company, of Wallsend-on-Tyne, is to construct for the Manchester corporation promise to be the largest yet made for the purpose in Great Britain, the total power for each of the two being over 6000 horse-power. It is interesting to note that this is the fourth large electric engine contract which Mr. Andrew Laing has carried out at the Wallsend works. The Manchester engines are to be of the triple-expansion type, but with four cylinders and four cranks.

PROMOTING ELECTRICAL INDUSTRY.—Lord Avebury presided over a special meeting of the London Chamber of Commerce, when an address was delivered by Mr. R. P. Sellon, chairman of the electrical trade section of the chamber. Mr. Sellon urged that the backwardness of England in the practical application of electrical science was due to restrictive legislation, which had no counterpart in those countries, such as the United States, Germany, and Switzerland, which had taken full advantage of the possibilities of electrical science. The Electric Lighting Act of 1882 proved practically fatal to the introduction of electricity supply. Nothing was done by municipal authorities, and it was found impossible to raise private capital in the face of a purchase clause which empowered the surrender of the undertaking in 21 years for a sum representing only the value of the plant and buildings. The amending Act of 1888 extended the tenure to 42 years, but the power of veto possessed by the local authorities still interposed an obstacle to the free expansion of electricity supply. Why were there 15,000 miles of electric tramways in the United States against less than 500 in Great Britain? This anomaly was traceable to the Tramways Act, 1870, which contemplated horse tramways exclusively, but by it electric traction found itself governed for nearly two decades. Less than 50 miles of electric traction were constructed in Great Britain until the Light Railways Act, 1896. The effect of the Tramways and Electric Lighting Acts upon the manufacturing industry might be judged from the fact that the capital employed in electrical plant production in Great Britain was less than one-fifth of that in Germany and one-tenth of that in the United States, while the system of heterogeneous specifications under which local authorities had purchased their installations had made standardization and specialization practically impossible. Amendment of existing legislation was indispensable. If afforded a fair field, the development of electricity supply and traction within the next ten years might be expected to engage, at a modest computation, £250,000,000 of capital. He urged that a standing committee, or some other body representative of the electrical industry, should be created, with which Government and State departments should confer when framing or amending legislation or regulations affecting the industry.

General News.

THE TELEPHONE.

ABBEVILLE, LA.—The long-distance telephone lines have been completed to this city, and connections made by the Cumberland Telephone & Telegraph Company. Alexandria is in telephonic communication with New Orleans and all places south of here.

DETROIT, MICH.—The Co-operative Telephone Company has been organized here with a capital of $200,000, and it has asked the People's Telephone Company for a price on its plant. The company will equip a plant in opposition to the Bell company and intends eventually to dispose of its plant to the city. The officers are F. F. Ingram, president; Hamilton Carhart, vice-president; Wilbur Brotherton, secretary; C. M. Burton, treasurer.

PORT HURON, MICH.—The outfit of the Harrison Telephone Company, which had been taken down by the city after being condemned as being in an unsafe condition, was sold at auction and all but the junk was purchased by the Citizens' Electric Light Company, the projected rival concern to the old light company.

RED WING, MINN.—E. E. Peck is figuring on establishing an independent telephone plant here and says that if a subscription of $5,000 is made to a capital of $18,000 he will install a modern system with conduits in the business section.

MOUNTAIN LAKE, MINN.—The Mountain Lake Telephone Company has recently built a 17-mile toll line to Comfrey and Darfur and contemplates building one or two small town plants in the spring. The present switchboard has a 50-drop capacity, the apparatus being that of the Stromberg-Carlson and Standard companies. The company now has 66 subscribers.

ST. LOUIS, MO.—Manager Henry Weaver, of the Planter's Hotel, has let a contract for a complete telephone system in that hostelry. Each of the 360 rooms will be supplied with the latest style instruments, and a switchboard will be placed in the office and two operators will be stationed there throughout the day. Besides securing connection all over the hotel, any telephone in and out of the city may be reached.

RALEIGH, N. C.—The Bell Telephone Company has completed long-distance connections between Raleigh and all outside points.

REIDSVILLE, N. C.—The Reidsville Telephone Company has been incorporated with $6,500 capital. The incorporators are R. J. Oliver, C. N. Evans and others.

TARBORO, N. C.—Mr. Geo. Hoderness, of Tarboro, president of the Carolina Telephone & Telegraph Company, states that his company has bought the exchanges at Smithfield, N. C., together with the toll lines. He also states that a copper wire will be built from Raleigh to Selma.

WILLIAMSTON, N. C.—The Williamston Telephone Company contemplates extending its lines to Jamesville and Hamilton, N. C. Its present switchboard capacity is 100 drops, the apparatus used being that of the Phœnix Electric Telephone Company. The Williamston company now has 70 subscribers.

CALLAWAY, NEB.—A plan for the construction of a telephone line from this place to various points in the country and to Oconto Lodi, Triumph and Arnold is now under consideration.

BENEDICT, NEB.—A telephone company has been organized in Benedict with a capital stock of $10,000. Mr. E. E. Watts is president. It is the intention to run a line to York, Stromsburg, Thayer and Gresham, besides connecting all the farmers on the way.

PHILLIPSBURG, N. J.—The Warren Telephone Company, of Phillipsburg, N. J., has been incorporated, with a capital of $100,000. The incorporators are M. T. Lynch, John H. McGrath and Howard Mutchler.

GREENVILLE, OHIO.—The Greenville Home Telephone Company, has increased its capital stock from $50,000 to $100,000.

CANTON, OHIO.—The Canton exchange of the Stark County Telephone Company is now in operation, with 600 telephones.

MARION, OHIO.—The Marion County Telephone Company has secured quarters for its exchange, and apparatus will be installed as soon as possible.

SHELBYVILLE, OHIO.—Farmers in this community are organizing a company to build a farmers' line in connection with the Mutual Telephone Company of this place.

NEW BALTIMORE, OHIO.—The New Baltimore & Venice Telephone Company has been incorporated with $50,000 capital stock to build exchanges in the towns mentioned.

BOWLING GREEN, OHIO.—The Central Union Telephone Company is making extensive improvements to its service. A new switchboard, cables and instruments will be installed.

MIFFLIN, OHIO.—The M. & W. Telephone Company has elected the following-named officers: Dr. J. H. Hutchinson, president; J. H. Stillwagon, secretary, and B. J. Aby, treasurer.

FINDLAY, OHIO.—On complaint of a citizen an injunction has been allowed restraining the Home Telephone Company from charging in excess of $12 per annum for its residence service.

POMEROY, OHIO.—The Pomeroy Home Telephone Company is extending its lines to Coolville, Olive, Chester and Orange townships. Direct connection will be made to Athens and Parkersburg.

NAPOLEON, OHIO.—The Citizens' Mutual Telephone Company is preparing to build an independent system in this place. The Bell company has also applied for a franchise in the town.

BROADWAY, OHIO.—Fire a few evenings ago destroyed the telephone exchange and its equipment, entailing a loss of about $5,000, the insurance being half that amount. The town is cut off from telephonic communication.

MECHANICSBURG, OHIO.—The suit brought by C. H. Marvin to secure a receivership for the Mechanicsburg Telephone Company has been settled out of court. C. H. Marvin retires from the company and affairs will be conducted as heretofore.

COLLEGE CORNER, OHIO.—Messrs. T. B. Barkley, C. E. Ardery, James Ardery, J. C. Barkley, James James, Dr. B. F. Forry, John Brier, Chas. Stout, Jacob O. Urban and W. E. Blake will incorporate the College Corner & Southern Telephone Company.

BEAVER, OHIO.—W. H. Ruhlman, of North Lima, Ohio, has succeeded in organizing a local telephone company in Beaver. Two hundred subscribers have been obtained. The new company will be given long-distance service over the independent lines.

PAINESVILLE, OHIO.—The Painesville Telephone Company held its sixth annual meeting a few days ago, re-electing the old officers. The company is erecting a new exchange building and is planning some extensive improvements to switchboards and lines.

HAMILTON, OHIO.—The City & Suburban Telegraph Association has been operating in this city for over twenty years on a franchise granted to an individual. Such franchises have recently been held invalid and the company has just secured a substitute franchise from the city.

LIMA, OHIO.—The Lima Telephone & Telegraph Company held its annual meeting recently, electing the following directors: D. J. Cable, C. H. Cory, W. H. Duffield, J. R. Sinclair, C. F. Stolzenbach, George W. Beers, Maxime Reber, H. D. Critchfield and J. B. Hoge. The company's new equipment has been practically all installed and service will open about Feb. 1.

JACKSON, OHIO.—The Jackson Home Telephone Company held its annual meeting recently. E. L. Sternberger was elected president; T. J. Morgan, vice-president; C. W. Haslett, second vice-president; M. D. Jones, secretary-treasurer. The three exchanges operated by the company are making rapid progress. Over 700 lines are now in use and 1000 will be put in by July 1.

ST. PARIS, OHIO.—The St. Paris Telephone Company has elected the following officers: C. E. Buroker, president; J. D. Poorman, vice-president; Frank A. Zimmer, treasurer; H. M. Black, secretary. The usual dividend was declared. Affairs of the company were reported to be in an excellent condition and prospects for the year very bright. Improvements will be made.

AKRON, OHIO.—The Akron People's Telephone Company held its annual meeting a few days ago. Officers were elected as follows: Will Cristly, president; C. W. DeVoe, vice-president; J. R. Nutt, treasurer; J. S. Benner, secretary, and W. F. Laubach, general manager. The report shows that the company is in an excellent condition, with total net earnings after paying interest on bonds of $18,499.79. Contrary to general report this company is not controlled by the Federal Telephone Company.

DOYLESTOWN, PA.—The United Telephone Company has been granted a local franchise for Chalfant.

BRADFORD, PA.—One hundred of the 500 local subscribers to the Bell Telephone service have ordered their service discontinued, because the company declined to meet the rates made by a rival concern.

NORRISTOWN, PA.—An ordinance has been presented to the Town Council by the Montgomery Subway Company for a franchise to construct a subway through the borough, in which wires of all kinds shall be placed.

ABERDEEN, S. D.—The Dakota Central Telephone Company has purchased the Aberdeen telephone exchange and will remove the central office to its new headquarters.

BRAINARD, S. D.—A rural telephone system embracing about forty telephones is being agitated in Brainard township by the farmers. The project will doubtless materialize.

SIOUX FALLS, S. D.—The Citizens' Telephone Company, of Sioux Falls, has been incorporated; capital, $200,000. Incorporators: E. W. Coughran, W. T. Doolittle, H. H. Natwick, G. W. Burnside and J. R. Conway.

CHATTANOOGA, TENN.—The Alabama & Georgia Telephone Company was granted a twenty-year franchise in the city. An exchange will be established at once.

NASHVILLE, TENN.—The Memphis Telephone Company has increased its capital stock from $400,000 to $600,000. This is the company which is putting in the independent telephone system in Memphis and its promoters are behind the Nashville Telephone Company which is seeking a franchise from this city.

SALT LAKE CITY, UTAH.—P. W. Madsen and S. F. Fenton will apply to the City Council for a franchise to establish an independent telephone system.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has given an order for the purchase of 100,000 pounds of copper wire, making 400,000 in all purchased this year.

KEYSER, W. VA.—The telephone line between Romney, W. Va., and Gore, Va., has been purchased by Mr. Hoover, proprietor of the Winchester Telephone Company and the Gore line. He will make many improvements in the service.

DAVENPORT, WASH., is now connected with the mining camps in the Cedar Canyon district by a telephone line constructed by C. A. Galloway.

BARABOO, WIS.—A factory for the manufacture of telephones is to be established at Baraboo.

SAUK CITY, WIS.—The Big Hollow Telephone Company, capital stock $15,000, has been incorporated by M. Sanson, H. J. Ellepson and A. Friederichson.

CAMBRIDGE, WIS.—The Prairie Queen Telephone Company connects Cambridge, Utica and Stoughton. It contemplates extending its line to reach all farmers in the vicinity of the towns named.

LAKE MILLS, WIS.—The officers of the Interurban Telephone Company, of Madison, have closed the deal for the purchase of the Lake Mills Telephone Company. The new company expects to improve the line.

MENOMINEE, WIS.—The M. A. Schmoyer Company has been granted a franchise by the village authorities to construct and operate a system of telephone lines and exchanges for local and long distance service.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company is seeking to consolidate all the independent telephone companies in Wisconsin into one organization to establish a long-distance system in the State. A. W. Hutchinson, of Weyauwega, Wis., is president of this company.

MILWAUKEE, WIS.—The Interurban Telephone Company, of Madison, was recently incorporated by A. L. Hutchinson, H. E. Kipler and Charles Schennecker. The capital stock is $200,000. The company will construct, operate and maintain a system of telephone lines and exchanges in this State, and which may be extended outside this State.

MILWAUKEE, WIS.—The Great Western Telephone & Telegraph Company recently formed and incorporated, has been seeking a franchise from this city. At the same time two other newly organized independent companies asked for franchises, but were turned down. The Great Western company is still in the field with the Wisconsin Bell Telephone Company, fighting every movement. The majority of the Common Council seems in favor of a new telephone company.

ELECTRIC LIGHT AND POWER.

HUNTSVILLE, ALA.—It is stated that at the next meeting of the City Council a special committee will report in favor of establishing a municipal electric light plant. S. M. Blalock, representing the Westinghouse Company, has been in Huntsville to make estimates.

HARTFORD, CONN.—Mr. Charles R. Reynolds, electrical inspector for the Hartford Board of Fire Underwriters, reports that there are used in Hartford 77,000 incandescent lamps, 1934 arc lights and 3650 horse-power in motors.

SAN FRANCISCO, CALIF.—The Copperopolis company recently placed orders in San Francisco for an electric light and power plant for the use of its mines in the Baker City region in Eastern Oregon.

SAN FRANCISCO, CALIF.—The Butters Company, which is working the tailings in Six-Mile Canyon, Nev., by the cyanide process, has three years' work in prospect at one point. Electricity will be used in the process and 200 tons per day will be handled. Electric current has been contracted for.

SAN FRANCISCO, CALIF.—A 6000 candle-power electric searchlight has been installed in the high tower of the ferry depot building, in San Francisco, by order of the State Harbor Commissioners. During the prevalence of fogs, the rays will be directed in such a way as to guide the captains of ferryboats in finding and entering the slips.

SAN FRANCISCO, CALIF.—The San Joaquin Electric Company's property in Fresno and other places in California will be sold under an order of the court as a result of litigation in which the Mercantile Trust Company, trustee, is the plaintiff. The total amount due the creditors is $683,494.49. No bid of less than $350,000 will be received by Attorney Lynn Helm, appointed special master. The company is given eight months in which to pay the debt.

SAN FRANCISCO, CALIF.—The Standard Electric Company recently completed its dam, located twelve miles from Jackson, Amador County. The distance from the electric power station is three-quarters of a mile. The dam is built of earth, and its upstream side is faced with rock. It is 700 feet in length on the top and 127 feet in height. A tunnel 3000 feet in length connects the retaining dam with the electric power house. The plant could be operated for eight days by the water retained by this dam alone.

MONTREAL, CAN.—Fire a few days ago damaged the works of the Royal Electric Light Company to the extent of $50,000.

VENICE, ILL.—The Venice Electric Light & Power Company, which holds the contract for lighting the Tri-cities, is preparing to increase its power by the addition of several new generators. This action is taken in view of the rapid increasing demand for lights.

INDIANAPOLIS, IND.—The Board of Public Safety having awarded the contract to the New Telephone Company for transmitters and receivers in the Gamewell police boxes, now discovers that it cannot operate the boxes without a switchboard and the Central Union Company, which had the contract last year, will remove its switchboard. A new one is needed, and there is a dispute between the Board and the New Company as to whether a switchboard was included. The company wants $250 extra for putting in the necessary switchboard.

BOISE, IDAHO.—The sum of $150,000 has been paid to the First National Bank of Boise for the entire capital stock of the Capital Electric Light, Motor & Gas Company. The purchaser is the Boise-Payette Electric Power Company.

ALBERT LEA, MINN.—The Albert Lea Light & Power Company, with a capital stock of $400,000 authorized, $125,000 of which is to be paid in cash, has been organized here, with George C. Edwards, of Bridgeport, Conn.; Frank N. Jewett, of Chicago; Mark M. Jones, B. J. Shockley, and Samuel S. Edwards, of this city, as incorporators. The new company will take over the plant and business of the Albert Lea Electric Company, and will furnish electricity and hot water heat.

ST. LOUIS, MO.—The Magnatite Foundry Company is increasing its electrical equipment.

ST. LOUIS, MO.—The Missouri-Edison Electric Company on Jan. 14 re-elected officers as follows: S. M. Dodd, president; James Campbell, vice-president; S. B. Pike, secretary; John G. Kelly, treasurer. These, with the following, constitute the board of directors: Thomas H. West, James W. Bell, R. C. Kerens, Edwards Whittaker and J. C. Van Blarcom.

ST. LOUIS, MO.—The Imperial Electric Light, Heat & Power Company, which has caused many complaints and a great deal of trouble regarding the installation of a smoke consumer at its plant, has notified the city authorities that it is now negotiating for a smoke consuming device, and that it will be put up as quickly as possible. The city has given the company until Jan. 30 to close the contract.

REIDSVILLE, N. C.—The town has ordered one 60-kw alternator from the Westinghouse Electric & Manufacturing Company, to be added to the electric light plant.

ALBANY, N. Y.—The Electric Light Company, of New Paltz, has been incorporated with a capital of $20,000. The directors are J. L. Cunningham, of Paterson, N. J., and F. K. Gillespie and E. C. George, of New York City.

ALBANY, N. Y.—The Binghamton Light, Heat & Power Company, of Binghamton, has been incorporated, with a capital of $500,000, to furnish electricity in Binghamton, Lestershire, Port Dickinson, Union, and other places in Broome County. The directors are Frank Cunningham, T. M. R. Meikleham and Thos. J. Waters, of New York City; William B. Dinsmore, of Tuxedo Park; George W. Dunn, Clarence F. Hotchkiss, F. W. Jenkins and George F. Johnson, of Binghamton, and Chauncey Eldredge, of Boston, Mass.

CALDWELL, OHIO.—The Caldwell Electric Light Company will increase the capacity of its plant.

GALION, OHIO.—A company composed of Galion people has secured a franchise for an electric lighting and steam heating plant.

CUYAHOGA FALLS, OHIO, has raised $5,000 on bonds for a dynamo and engine for lighting to be operated in the city water works.

LA RUE, OHIO.—J. W. Barber, of Columbus, and H. E. Hill, of Marion, are endeavoring to secure franchises for electric lighting systems in La Rue and Prospect.

SALINEVILLE, OHIO.—The Salineville Electric Light, Heat & Power Company has been incorporated with $15,000 to build a lighting and power plant and to furnish steam heat.

BUTLER, OHIO.—A telegram from Butler, Ohio, says municipal ownership of the electric light plant there is a failure. Notwithstanding the receipts are large, there is a deficit of $500 per month.

BELLVILLE, OHIO.—The municipal lighting plant which was installed some months ago, threatens to bankrupt the village. The plant has run behind about $1,000 in two months and the leakage can not be discovered.

COLUMBUS, OHIO.—At the recent annual meeting of the Columbus Edison Electric Light Company officers were elected as follows: President, Adolph Theobald; vice-president, John Siebert; secretary and business manager, A. W. Field; treasurer, Emil Kiessewetter.

BUTLER, OHIO.—The municipal lighting plant which was installed some months ago is proving a great disappointment to citizens. The monthly income of the plant is $125 and the expenses over $200. There is now a deficit of over $1,000 and three of the six Councilmen have resigned as a result of the general complaint.

CINCINNATI, OHIO.—A company calling itself the Universal Electric Light Company has obtained an option on the property of the Wyoming Electric Light, Heating & Power Company. The latter company furnishes light in the villages of Wyoming and Lockland, and is incorporated for $50,000. It is supposed that the Cincinnati Gas & Electric Company is back of the deal.

BENNETTSVILLE, S. C., is issuing bonds for an electric light plant. Mr. J. M. Jackson is of the committee having the matter in hand.

NASHVILLE, TENN.—Bids have been opened in Nashville for wiring the city in connection with the new electric light plant. The work will probably cost $10,000.

DUBLIN, TEX.—The Dublin Light & Power Company, of Dublin, Tex., capital stock $20,000, has been incorporated by R. W. Higginbotton, J. N. Higginbotton and T. L. Higginbotton.

DALLAS, TEX.—Granville P. Mead, of Fort Worth, Tex., has been appointed by the Federal Court receiver of the Standard Light & Power Company, of Dallas, upon application of the General Electric Company of New York. The amount involved exceeds $50,000.

DALLAS, TEX.—The Standard Electric Light & Power Company, of Dallas, which the city authorities have accused of being a trust, with other local companies, was placed in the hands of a federal receiver Jan. 11 on application of the General Electric Company, of New York, which claims to hold $55,000 worth of the Standard company's bonds.

SALT LAKE CITY, UTAH.—H. C. Edwards is seeking an electric light franchise in this city.

SALT LAKE CITY, UTAH.—Electric energy generated at Snoqualmie Falls by the Snoqualmie Light & Power Company may be carried to Portland, Ore., over 180 miles of wire.

SALT LAKE CITY, UTAH.—A new company has been formed at Weises, Idaho, to build a dam to cost $280,000 to reclaim 40,000 acres of land. It is said the company will also erect a power plant at the dam site.

SALT LAKE CITY, UTAH.—The White Beaver Mining Company, of Rossland, B. C., has placed an order for a new powerful electric hoist to be installed necting Nyack, Sparkill and other villages of Rockland County.
rapidly as possible.

SALT LAKE CITY, UTAH.—Plans are under consideration by the Utah Light & Power Company to carry into effect the construction of a large dam in Ogden Canyon to impound sixteen billion cubic feet of water. The cost of the dam will be about $350,000.

NEWPORT NEWS, VA.—The Consumers' Heat, Light & Ice Company has offered for sale to the city its electric light plant. The company is now being sued by a New Jersey corporation, but fifteen days were granted during which the City Council was to consider the offer.

SALT LAKE CITY, UTAH.—Captain Tice, of Baker City, Ore., will organize a company backed by Eastern capital for the generation of electric power for operating the mining and manufacturing machinery of Baker City. The company will use the water of Eagle Creek.

SALT LAKE CITY, UTAH.—The E. W. Clark Light & Power Company, of Tooele, is about ready to commence work. The plant will be located in Tooele Canyon, of 300 horse-power, and capable of furnishing light and power to Stockton, Tooele and very likely to Grantsville.

SALT LAKE CITY, UTAH.—A company will be formed of Eastern capital to build a large power plant on the Santiam River, Ore. A dam 60 feet high and 230 feet long has been built by private parties, and it is at this point the plant will be installed. It is understood that the lumber mills in the vicinity will contract for power as well as a number of small towns in the county. The proposed plant will be of 500 horse-power, driven by means of a new turbine patented by a Portland man.

SALT LAKE CITY, UTAH.—Regarding the big power scheme by which the mines of the Idaho district along the Wood River are to be supplied with electricity, a representative of the company says: "The syndicate that is to put into execution the Hollister scheme for an electric power plant at the Shoshone Falls began active operations last week, when miners were put to work at the Falls. Work will be pushed as rapidly as possible, and one of the finest plants in the western country will be installed."

MADISON, WIS.—Madison is to have a new gas and electric light company. The articles of incorporation have been filed. The incorporators are Henry H. Morgan, Henry T. Sheldon and M. H. Oakley, and the capital stock has been placed at $200,000.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has been granted the privilege of making certain connections between car lines on Twenty-first Street and Third Avenue.

NEW HAVEN, CONN.—Application has been made to the Superior Court to change the name of the Thompson Tramway Company to the Worcester and Connecticut Eastern Railway Company. This probably is the first legal step toward the formal consolidation of the electric roads in the northeastern part of the State, and reaching to Worcester, Mass., in one organization.

VALLEJO, CALIF.—A franchise for an electric street railway in this city has been granted to J. W. and H. F. Hartzell, of San Francisco.

SAN FRANCISCO, CALIF.—The North Shore Railway Company was recently incorporated, with San Francisco as the principal place of business. Directors: R. R. Colgate, John Martin, E. J. de Sabla, Jr., R. M. Hotaling, A. Borel, J. C. Coleman, C. de Guigne, A. H. Small and E. Coleman. Capital stock, $6,000,000; subscribed, $90,000. An electric railway will be constructed from San Rafael to Sausalito, Calif., and swift ferryboats will make close connections with San Francisco. Various extensions will be made in time.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Rapid Transit Company has executed a mortgage for $750,000 for the purpose of issuing bonds to that amount. The Union Trust Company and the Security Trust Company, of this city, are named as trustees. The mortgage will be filed in Marion, Hendricks and Morgan counties, through which the road will pass. The bonds are to be of thirty years' duration and will bear interest at 5 per cent.

NOBLESVILLE, IND.—The Central Traction Company has awarded the contract for 150,000 ties for the Indianapolis division of its road. It also awarded the contract to the Carnegie Steel Company for the rails. Both contracts call for immediate delivery. Several large firms are figuring on the contract for the power-house to be erected in this city at once.

DES MOINES, IA.—The Toledo Electric Railway has filed articles of incorporation with the Secretary of State, showing a capital of $200,000. This is the line which is being promoted by P. E. Hall, of Cedar Rapids, and is projected to run from Traer, Ia., in a southerly direction through Toledo and Tama and on south into the coal regions of Mahaska County, terminating at the town of Buxton. W. C. Walters has been elected president of the company; J. R. Caldwell, vice-president; C. E. Walters, secretary, and H. A. Shanklin, treasurer.

NEW ORLEANS, LA.—The deal whereby the syndicate, represented by H. H. Pearson, Jr., will assume control of the New Orleans City Railway Company, is announced as completed, the new owners to take charge March 1.

BALTIMORE, MD.—Final arrangements have been made to charter the Baltimore & Frederick Electric Railway Company. This corporation is formed to build the trolley line from Baltimore to Frederick. Messrs. Frank H. Callaway, John W. Ellard and James E. Ingram, Jr., of Baltimore, with Messrs. J. Roger McSherry and Johnzie Beasman, of Frederick, will be the incorporators. The new company will be chartered under the general laws of Maryland and will have a capital of $1,500,000. The line will be 45 miles long between Baltimore and Frederick.

ALBERT LEA, MINN.—The Albert Lea Light & Power Company, that expects to secure the building of an electric line of railway from this city to Mankato, and which has a capital stock of $400,000, has perfected its organization, as follows: President, George C. Edwards, of Bridgeport, Conn.; vice-president, Frank N. Jewett, Chicago; secretary, Norman Peterson, Albert Lea; treasurer, Benjamin J. Shockley, Albert Lea. The new corporation stepped into the business of the Albert Lea Electric Company, and will expand that plant as well as promoting the railroad enterprise.

TRENTON, N. J.—The Delaware Valley Traction Company has been incorporated; capital, $100,000. Incorporators: Wm. A. Buckman, Geo. Buckman and Wm. F. Sadler, Jr.

ASBURY PARK, N. J.—A committee representing the holders of $507,000 worth of the $800,000 5 per cent first mortgage bonds of the Atlantic Coast Electric Railway Company, has applied to the Chancery Court for a receiver for that company.

HOLLY BEACH, N. J.—The Five-Mile Beach resorts of Anglesea, Wildwood and Holly Beach will be connected by a trolley road before the opening of the season. An ordinance granting a franchise to the Cape May and Anglesea Traction Company to construct a trolley road through Wildwood will be granted.

ALBANY, N. Y.—A hearing has been given before the State Board of Railroad Commissioners on an application of the Rockland County Traction Company to construct and operate an electric railway line thirty miles long, connecting Nyack, Sparkill and other villages of Rockland County.

AKRON, OHIO.—The Northern Ohio Traction Company will institute an all night service on its city line.

MT. VERNON, OHIO.—The Mt. Vernon Electric Railway has obtained a franchise for an extension of its lines.

TOLEDO, OHIO.—The annual meeting of the Toledo Railways & Light Company was held Jan. 16. The old officers were re-elected.

COLUMBUS, OHIO.—Officials of the Appleyard syndicate announce that through service will be opened between Columbus and Cincinnati by July 1.

BUCYRUS, OHIO.—The promoters of the proposed Bucyrus, Upper Sandusky & Lima Railway claim they have secured the necessary backing for their road from New York people.

DAYTON, OHIO.—General Manager Rannells, of the proposed Dayton & Kenton Traction Company, announces that a contract for constructing the road has been placed with Falk Brothers, of Milwaukee.

WELLSVILLE, OHIO.—The East Liverpool Street Railway has been notified that it must operate 12-minute cars instead of a 24-minute schedule, as at present. The Council will take action if the order is not complied with.

GREENVILLE, OHIO.—The Greenville Council has granted a 25-year franchise to the Richmond & Greenville Traction Company. The road will be an extension of the Dayton & Northern Traction Company's road now in operation to Greenville.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway held its annual meeting Jan. 15. The following officers were elected: L. Black, president; W. M. Tuller, vice-president; E. M. Friess, secretary, and A. Forney, treasurer.

STEUBENVILLE, OHIO.—It is stated that a syndicate headed by J. J. Hensel and Thomas M. Goodman, of New York, and Theodore Ward, of Philadelphia, is planning to build an electric line from Steubenville to Youngstown by way of Lisbon, Salem, Leetonia and Canfield.

COLUMBUS, OHIO.—A certificate has been filed with the Secretary of State consolidating the South Canton Belt Line Railway Company and the Middle Branch & Canton Belt Line Railway Company under the name of the Canton Belt Line Railway Company. The capital stock is $25,000.

SPRINGFIELD, OHIO.—At the annual meeting of the Dayton, Springfield & Urbana Railway, held Jan. 16, the stockholders decided to double track the line from Dayton to Springfield. Officers were elected as follows: John S. Harshman, president; John G. Webb, vice-president and secretary, and A. E. Appleyard, treasurer.

CLEVELAND, OHIO.—The annual meeting of the Cleveland, Elyria & Western Railway was held Jan. 16. A quarterly dividend of ¾ per cent. was declared. Officers elected: A. H. Pomeroy, president; A. E. Aikens, vice-president; F. T. Pomeroy, treasurer and general manager; E. F. Schneider, secretary; J. O. Wilson, general passenger agent.

STEVENS POINT, WIS.—The Wisconsin Valley Power & Light Company has had in view for some time the construction of an interurban electric railway connecting Stevens Point with Grand Rapids. D. O. Fisher is one of the promoters of this enterprise.

THE AUTOMOBILE.

AUTOMOBILE LINE ON EADS BRIDGE.—The capital stock of the Interstate Traction Company at Belleville, Ill., has been increased to $250,000. This company will operate an automobile line across the Eads Bridge at St. Louis.

THE GOODRICH MOTOR VEHICLE COMPANY, of Omaha, has incorporated to manufacture motors and vehicles of various kinds. It is capitalized for $200,000 and the principal incorporators are: O. A. Goodrich, M. T. Munsinger, John N. Westberry, R. A. Talbot and James Barrett.

TO BUILD AUTOMOBILE STABLES.—Edmund C. Stout, of the firm of Hill & Stout, architects, will undertake a new form of speculative building in the erection of five automobile stables on East Seventy-fifth Street, New York. Mr. Stout has acquired the property from Daniel E. Seybel. Each one of the new buildings will have a frontage of eighteen feet and will be three stories in height. The first floor will be used for the storage of automobiles and will be provided with all facilities for charging those of the electric type. On the second floor will be a room for the owners' use, while the top floor will be fitted up as a living apartment for chauffeurs. It is said that the total amount involved in the undertaking is not far from $300,000.

LEGAL.

SUBMARINE BOAT SUIT.—Suit has been brought in the United States Circuit Court for the Southern District of New York, by the Electric Boat Company, the builders of the Holland sub-marine boat, against the Lake Torpedo Boat Company for infringement of the patents owned by the former company. A submarine torpedo boat now being built by the Lake Torpedo Boat Company at Bridgeport, Conn., is the bone of centention which has roused the struggle in the courts. This boat was designed by Simon Lake, who several years ago built the Argonaut, a boat which dived beneath the water and crawled on the bed of the river, bay, and ocean. In the complaint of the Electric Boat Company a general infringement of its patents is claimed, and it is specifically alleged that its patents are infringed in general safety devices, in arrangement of the storage battery, arrangements for drainage and ventilation, arrangement of ballast tanks, and arrangement for automatic compensation for loss of weight after the shooting off of torpedoes. In the infringement suit, $100,000 damages and an injunction preventing further work on the boat now being constructed at Bridgeport are asked.

TELEPHONE LITIGATION.—In the appeal of the American Bell Telephone Company from the Berliner decision in favor of the National and Century Telephone Manufacturing companies, the United States Circuit Court of Appeals in Boston has granted the continuance asked for by the Bell company until the April term. The continuance was opposed quite strenuously.

PERSONAL.

MR. EGBERT H. GOLD, of Chicago, is no longer connected with the Gold Car Heating Company.

MR. C. J. PURDY, Eastern representative of the Northwest Fixture Company, Seattle, Wash., has gone on a trip to the Pacific Coast.

MR. HENRY A. TRUITT has bought from Mr. Thomas Gibb the entire right, title and interest in the Imperial Electric Company, of Philadelphia.

JUDGE E. H. GARY, of United States Steel, has been elected chairman of the Allis-Chalmers Company. Mr. William Allis retires on account of ill-health.

MR. NEWCOMB CARLTON, lately so prominent in the management of the Pan-American Exposition, has been elected vice-president of the Bell Telephone Company of Buffalo.

MR. G. MARCONI, who already has the Order of the Crown of Italy, has now been decorated by the King with the Order of St. Maurice and St. Lazarus.

MR. S. L. COLES has had a couple of good articles recently in *Collier's Weekly* on the old, new and coming rapid transit facilities in New York City. He sees great opportunities for improvement in the present situation.

MR. ROBERT E. HAMBLIN, manager of the Toledo, Bowling Green & Southern Traction Company, has accepted the position of general manager of the Toledo Home Telephone Company. He will assume charge Feb. 1.

PRESIDENT A. B. CHANDLER, of the Postal Telegraph & Cable Company, has been writing very interestingly in the *Saturday Evening Post* about the openings, or lack of them, for young men in the modern telegraph field.

MR. G. R. NEWCOMER, formerly United States representative for the United States Carbon Company, has opened an office at 39 Equitable Building, Memphis, Tenn., as Southern representative of the Commercial Supply Company of St. Louis.

PROF. W. E. GOLDSBOROUGH has now been confirmed as chief of the department of electricity for the St. Louis Exposition of 1903, and will have under his charge all matters relating to the electrical exhibits. He is taking up his duties at once.

MR. LEWIS NIXON, naval engineer, proprietor of the Crescent City Ship Works at Elizabethport, N. J., and the new leader of Tammany, has an interesting and suggestive article in the February *Success* on the work that may be expected from submarine boats. He has lately been engaged in building several Holland boats for the Electric Boat Company.

MR. H. H. SYKES.—The appointment is announced of Henry H. Sykes, of St. Louis, Mo., to be general superintendent of the Southern New England Telephone Company. Mr. Sykes is now connected with the Missouri Bell Telephone Company. He will succeed E. B. Baker, whose resignation will take effect May 1, as already announced in this column.

MR. THOMAS P. THOMPSON, master electrician in the department of yards and docks in the navy yard at Norfolk, Va., has tendered his resignation to the Government and will engage in architectural and electrical engineering with the firm of Webb & Thompson, of Norfolk. The Government has ordered an examination to select a master electrician for this position.

MR. A. E. WINCHESTER, general superintendent and commissioner of the municipal lighting plant at South Norwalk, Conn., was in New York this week and reported a very successful year. He denied, however, the rumors attributing to the commission an intention to take over the local street railway. This story arose from some old arrangement as to supply of current.

MR. THOMAS A. EDISON is now a fireman. He has been made an honorary member of the Edison Hook and Ladder Company at Menlo Park, N. J., whose truck house was formerly the laboratory of the famous inventor. In this house the Edison work on the telephone, electric light and phonograph was done. It was there that the first installation of incandescent light was put in operation.

DR. S. SHELDON, of the Brooklyn Polytechnic Institute, delivered a very interesting lecture on Jan. 28 at its club rooms before the Automobile Club of America on "The Electric Motor." It was beautifully and profusely interspersed with experiments and was heard with much attention. Dr. Sheldon is to favor the club with a second lecture on "The Storage Battery" a fortnight hence.

MR. W. R. BRIXEY, manufacturer of insulated wires and cables, has had a very serious experience in connection with the explosion this week in the unfinished rapid transit subway opposite the Murray Hill Hotel, when half a dozen persons were killed and over 150 injured. Mr. Brixey has for some years occupied a suite of rooms on the Park Avenue side of the hotel and he and Mrs. Brixey were there at the time of the explosion. Mrs. Brixey was in an inner room and fortunately escaped any injury, but Mr. Brixey received the full blast and shock of the concussion and was terribly cut about the head by huge flying pieces of glass. When he and his wife got out of the hotel he very bravely refused assistance, telling the doctors to attend to other people, and, bleeding from his wounds, staggered to a doctor's office near by, where he swooned away. He was carried to the German Hospital and treated at once for fractured skull; and at last reports was doing as well as could be expected. The doctors hope that his sturdy English constitution will pull him through in good shape. That he emerged from the accident with his life is a miracle.

Trade Notes.

MR. HUGO REISINGER, 11 Broadway, New York, is sending out a very handsome calendar desk pad for 1902 as a reminder of "Electra" carbons.

DELTA METAL.—The Phosphor-Bronze Smelting Company, Limited, 2200 Washington Avenue, Philadelphia, has issued its January price list of its Delta metal.

KNAPP ELECTRIC & NOVELTY COMPANY, of New York City, finding it necessary to enlarge its plant, is removing to 511-513 West Fifty-first Street, and will be installed there this week.

CHANGE OF NAME.—The Interstate Insulating Company, of Sandwich, Ill., has changed its name to Illinois Electric Specialty Company and the company's capital has been increased from $2,500 to $7,000.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has just issued Circular No. 21 describing its line of dynamos and motors. Copies of this circular will be sent to the trade on application.

THE MILWAUKEE COMMUTATOR COMPANY, Milwaukee, Wis., is sending out some very fine bars made true to angle and gauge from pure lake copper. It is also doing a large business in copper and brass castings for the electrical trade.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY announces that it is fully prepared to furnish its new patented switchboard ringing and listening keys in any quantity, and is mailing a neat card with a cut of the key and full description.

NEW CENTURY PRIMER.—The New York & New Jersey Telephone Company is giving some education on the uses of the telephone in a booklet entitled "The New Century Primer." Twenty-six facts concerning telephone service are conveyed in nursery rhyme style.

THE SCHAEFFER & BUDENBERG MANUFACTURING COMPANY is the new style of the old firm which has long been making steam and boiler gauges, etc., under the name of Shaeffer & Budenberg. The New York address will be 66 John Street as before.

"FALCON" FLUSH RECEPTACLES.—In a leaflet of recent issue by the Falcon Electric Manufacturing Company, of New York, the Falcon extension plug and flush receptacle, and flush plug and flush receptacle are illustrated, in connection with information and prices of these devices.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising a new addition to the family of Adams-Bagnall arc lights. It is a series alternating in both shunt and differential types. The shunt type is the one used with the so-called regulator system, and the differential is for use with "tub" or transformer system.

THE ILLINOIS ELECTRIC SPECIALTY COMPANY has removed from its old office, 1203 Marquette Building, to 510-512 Tacoma Building, Chicago, where it will be pleased to meet its friends. It is receiving a large number of orders for its direct reading ohmmeter and it keeps its factory working overtime to supply the demand.

THE BRECHT AUTOMOBILE COMPANY, 1207 Cass Avenue, St. Louis, Mo., has issued a pamphlet of its automobiles, automobile gearing and parts. The Brecht gear is adapted for use with either electric, steam or gasoline vehicles, and the illustrations show it to be of neat appearance with a general look of solidity and gracefulness.

AUTOMOBILE SUPPLIES.—Mr. A. L. Dyke, St. Louis, Mo., recently issued some circulars giving illustrations and pointing out the chief advantages of several devices used in connection with automobiles. Mr. Dyke carries a large stock of Dyke engines, running gears, carburetters, tool sets and a general line of supplies for automobiles.

CHASE-SHAWMUT COMPANY, of 390 Atlantic Avenue, Boston, Mass., has just issued a very neat and handy little red book of electrical data and diagrams that should prove quite useful to a great many people. We understand it can be obtained by all interested in the company's fuse wire, switches, switchboards and other apparatus.

THE LINCOLN ELECTRIC COMPANY, 71 Ontario Street, Cleveland, Ohio, is making a line of dynamos and motors, which machines are illustrated and described in a catalogue and price list just issued by the company. The company manufactures bipolar and multipolar machines, elevator motors, plating dynamos and alternating-current dynamos. The pamphlet gives directions for setting up these machines.

THE CONTINENTAL TELEPHONE CONSTRUCTION COMPANY, Chicago, has closed the contract for the installation of a 600, fully equipped central energy switchboard and some outside construction, with 1500 capacity, at Freeport, Ill. On account of the increase in business this company has been compelled to seek larger offices and will now be located and doing business at Rooms 510-512 Tacoma Building, Chicago.

ELECTRICALLY-DRIVEN TOOLS.—Jas. Clark, Jr., & Company, Louisville, Ky., have issued a pamphlet on the "Willey" electrically-driven tools manufactured by them. Both the tools and motors are built in the same shop and adapted to each other. The firm is offering a line of enclosed type motors designed especially for driving individual machines. The motor is simple in construction and well designed to meet the requirements of such service.

THE REYNOLDS ELECTRIC COMPANY, of 221-225 Fifth Avenue, Chicago, is contemplating arrangements for enlarging its plant. This firm has in process of completion several new patented devices which will be of interest to electricians everywhere, and of which a more detailed story will be told in these columns as soon as it is deemed advisable. The rapidly increasing orders for the "Original Reynolds Flasher" makes the enlarging of its present plant an imperative necessity.

ELECTRICAL SUPPLIES.—The Central Electric Company, Chicago, Ill., has issued a complete price list of general electrical supplies. The pamphlet contains 174 pages with a very complete index. A noticeable feature of the work is the almost entire absence of illustrations, only a few of the newer and more important devices being thus shown. The space ordinarily occupied by illustrations is, however, entirely taken up by important information and figures regarding the articles listed.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, reports more orders for its Cross oil filters from the big steel corporations and other large concerns throughout the country. Excellence cannot be better attested than by "repeat" orders, which in its case means supplying a concern with anywhere from three to twenty-five filters. The Burt Manufacturing Company will be pleased to send its catalogues to any one interested.

DROP HAMMERS are indispensable machines in all forging shops. The Billings & Spencer Company, of Hartford, Conn., has given a good deal of information regarding its drop hammers, of which it makes a very full line, in a recent pamphlet. These machines are illustrated, both complete and in parts, the parts being numbered to facilitate ordering. Besides manufacturing drop hammers the company produces trimming presses, heating furnaces, machine tools, etc., and drop forgings of every description, in copper, bronze, iron and steel.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it has already closed a large number of fan contracts for the coming season. It is expecting an unprecedented demand. It is handling the Peerless for direct current, and the well known Emerson for alternating current. These fans are made up in an unusually large number of styles and types, and the company is prepared to furnish any voltage or alternation. It is issuing two very attractive catalogues, one covering the direct current fans and the other alternating, which will be mailed on application.

SLOT MACHINES FOR TELEPHONES.—The rapidly extending use of automatic telephone pay stations is evidence that they are satisfactory instruments. The American Toll Telephone Company, 43 Sheriff Street, Cleveland, Ohio, is one of the leading manufacturers of these devices, and has just issued a neat booklet describing and illustrating six different styles manufactured by it. These instruments are proof against tampering, and the company has such confidence in its machines that it offers to send them out on 30 day's trial, to be returned if not satisfactory.

BATES ELECTRIC FANS.—The ceiling and desk fans manufactured by D. L. Bates & Bro., Dayton, Ohio, are well known throughout the world. The firm has lately added a trunnion fan to their line. They make a specialty of fans for direct current only and as their product has been on the market for the past eleven years, it is a difficult matter to improve them, as changes have been made from year to year until perfection has been attained. The firm has about all they can do to supply the trade, even at this early date. They have issued a very pretty calendar, which will be gladly furnished to any one interested in fans.

GRAPHITE ELECTRODES.—The subject of graphite electrodes for use in electrolytic and electro-metallurgical processes is discussed at considerable length in a very attractive booklet of recent issue by the International Acheson Graphite Company, of Niagara Falls, N. Y. The manufacture of these electrodes and their properties are described, and the advantages to be derived from their use are pointed out. The general subject is well treated and the information contained in the pamphlet will no doubt be of much value to all interested in this line of work. Marginal references are printed in red to readily catch the eye, and the cover is of artistic design.

WESTERN ELECTRIC CATALOGUE.—We have received from the Western Electric Company a copy of its new general supply catalogue. It is a volume about 7½x5½ inches, handsomely bound in dark green cloth, and containing nearly eleven hundred pages and three thousand illustrations. It appears to contain everything which could possibly be wanted in any line of electrical industry, house goods, electric lighting and power supplies, street railway material, etc. The catalogue will be sent to any address, charges paid, on receipt of $1. It is virtually an illustrated dictionary of practical electricity and reflects great credit on the manufacturer it represents and the indefatigable compilers.

NEW FAN MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., is sending to the trade a circular letter calling attention to its new line of fan motors for the coming season. The desk and bracket fans for low frequency current have been improved by the addition of an automatic device which gives the motor a very desirable start and at the same time reduces the current consumption. An entirely new type of ceiling fan for low frequencies has also been brought out. The Emerson desk and bracket fans for high frequency current have been entirely redesigned and greatly improved, and a new type of trunnion desk and bracket fan for high frequencies has been added to the list.

THE NEELY ELECTRIC COMPANY, of 611 Fourteenth Street, N. W., Washington, D. C., has opened a thoroughly modern equipped electric establishment, probably one of the finest in the South. It has five distinct departments—electrical engineering and drafting, electrical machinery and motor, wholesale and jobbing, retail, construction and installing—in its new and commodious building. These departments are conducted and operated by experienced managers. The Neely Electric Company is unquestionably the largest Government contractor for things electrical. The location of the headquarters of this company, at the seat of the Government, no doubt, materially aids it in following the Government business and securing contracts.

REPAIRS OF ELECTRICAL APPARATUS.—A new firm in the repair business is that of the Charles G. Hose Electric Company, of New York City, who has oened a large repair shop for the express purpose of attending to the wants of all users of electric machinery. The president, Charles G. Hose, has had large experience, having been connected with the Brooklyn Rapid Transit Company for the past eight years in various capacities in the large repair shops of the company. The familiarity of Mr. Hose with all kinds of electrical apparatus from the practical side is supplemented by considerable business ability, and this, combined with the exceptional facilities possessed by the company, its machinery and operating force, have all resulted in a large amount of business. All kinds of work will be done, including the repairs on car controllers, commutators, generators, both alternating and direct current, and street railway and power motors, besides contracts for the complete wiring of buildings, car houses, offices, etc.

FREE SCHOLARSHIPS.—The Trustees of the American School of Correspondence are offering a few free scholarships in the engineering courses to deserving, energetic and intelligent young men. The course of study offers thorough instruction at home in mechanical, electrical, stationary, locomotive, marine and textile engineering, as well as heating, ventilation, plumbing and mechanical drawing, under instructors who are graduates of the great technical schools. Much of the instruction is under regular teachers in the technical schools for which Boston is famous. To the young man who has lacked the time and money to fit himself to be a master in his trade, such opportunities opens wide the doors to advancement and success. Though he may live hundreds of miles from an educational center, he nevertheless enjoys as a student in a correspondence school many of the advantages of the student paying $200 a year for tuition in the great technical schools. Indeed, it is one of the most important features of the American School that it is situated in close touch with institutions for technical training, and is thus enabled to engage exceptionally qualified instructors to supervise the work of the students. For the large handbook describing the courses, methods, etc., inquirers should address the Registrar of the American School of Correpondence, Boston, Mass.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 21, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

690,181. ELECTRIC ACCUMULATOR; Alfred Pouteau and Albert Wolff, Dijon, France. App. filed April 9, 1901. Perforated plates are separated by perforated partition bars, the interval between the two plates being filled with active material. Both the plates and partition bars are made of celluloid covered with a layer of caoutchouc. Within each compartment is a longitudinal core of conducting material, the cores of each element being connected at their projecting ends by a collector bar.

691,358. MEANS FOR DRIVING DYNAMOS FROM CAR AXLES; J. L. Creveling, New York, N. Y. App. filed Aug. 30, 1900. Mechanical devices are interposed between the driving axle and the armature shaft, whereby, if the car stops without breaking the circuit between the generator and the storage battery, no other effect will be produced than the conversion of the generator into a motor, the machine then running in the same direction as when acting as a generator.

691,359. MEANS FOR DRIVING GENERATORS PLACED UPON CARS BY POWER TAKEN FROM THE CARS; J. L. Creveling, New York, N. Y. App. filed May 10, 1901. A modification of the preceding invention.

691,360. ELECTRIC TRACTION; B. Cruvellier, Marseilles, France. App. filed Sept. 8, 1900. In an electric traction system, a contact-box provided with a closed chamber or cavity and an active electric circuit closer movable in said chamber or cavity and comprising a hollow sphere of conducting non-magnetic material, and loose magnetizable material inclosed in said sphere.

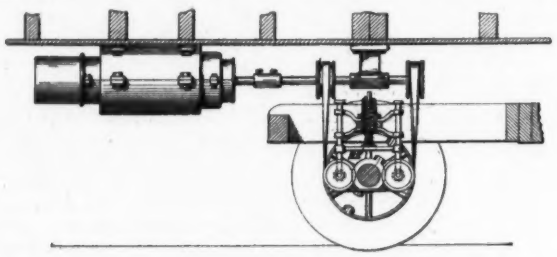
691,381. SUBTERRANEAN CURRENT TRANSMISSION FOR ELECTRIC TRAMWAYS OR RAILWAYS; A. Hrebicek, Bingerbruch, Germany. App. filed Sept. 12, 1899. The conduit is covered by plates having inclined grooves therein which are engaged by a projection carried by the car, whereby the plates are moved to uncover the conduit ahead of the collecting device and to close the conduit immediately behind it.

691,393. ELECTRICAL MEASURING INSTRUMENT; F. A. La Roche, New York, N. Y. App. filed April 29, 1901. The restraining spring of the movable coil is connected in shunt with the shaft or pivots upon which the movable system swings, so that the total current which is led into the instrument will be divided, one part of it passing through the scroll-wound spring and the other part through the pivots. The field of the movable element is a composite one, furnished by a permanent magnet, and by a pair of electro magnets in close proximity to the pole pieces, the permanent magnet being supplied with a coil for standardization. The two inductor electromagnets are in series and connected to the terminals of an ammeter shunt so that but a fraction of current passes through them. An optical method is employed for indicating the angular motion of the movable system.

691,394. ELECTRIC CUT-OUT; H. E. Leppert, New Britain, Conn. App. filed April 16, 1901. A rosette in which the cap is secured to the base by a threaded bushing passing through the cap and entering a thimble carried by the base. The cord passes through the bushing.

691,404. PORTABLE ELECTRIC WELDING MACHINE; H. E. Meyers, Butte, Mont. App. filed March 14, 1901. A box containing the primary and secondary and through the end of which the terminals of the secondary project, is constructed to be conveniently handled and carried about.

691,441. APPARATUS FOR DETERMINING THE FREQUENCY OF ALTERNATING CURRENTS; U. S. Carr, Lawrence, Kan. App. filed July 12, 1901. A stroboscopic disk is divided into alternate sectors with reflecting and non-reflecting surfaces. If the disk is revolved in the light produced by an arc or incandescent lamp connected to an alternating-current, slight fluctuations in the intensity of light will produce the illusion of a revolution of the sectors in one direction or the other whenever the current and the revolutions of the disk are not in synchronism. When the number of revolutions of the disk and the frequency of the current are the same, the sectors will appear stationary.



691,359.—Means for Driving Generators Placed Upon Cars by Power Taken from the Cars.

691,450. RECORDING SYSTEM; R. and W. H. Davis, Washington, D. C., and D. C. Woodbury, Hoboken, N. J. App. filed Feb. 16, 1901. (See page 226.)

691,470. METHOD OF MAKING ALUMINUM HYDRATE; H. W. Jordan, Syracuse, N. Y. App filed July 10, 1901. (See Current News and Notes.)

691,473. ELECTRIC TRACTION SYSTEM; C. M. J. Limb, Lyons, France. App. filed Jan. 26, 1901. The accumulators normally furnishing the propelling current are automatically recharged at every station, the starting after a stoppage at the station being effected by making use of the main charging current instead of the battery.

691,495. INSULATING CONDUIT FOR CONDUCTORS OF ELECTRIC TRAMWAYS; P. C. Seguy, Paris, France. App. filed March 5, 1901. The conduit comprises blocks of insulating material having a channel formed therein for the conductor and an opening in the bottom for the escape of water into a second block having a channel for carrying the water off.

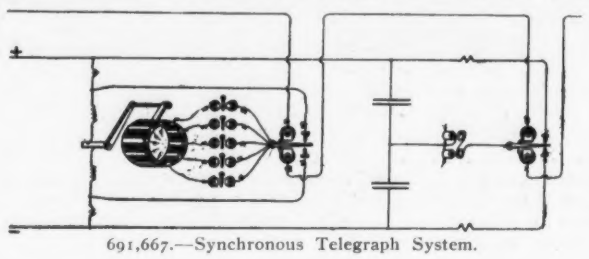
691,545. PORTABLE WATER PURIFIER AND FILTER; C. E. Holland, New York, N. Y. App. filed Jan. 9, 1901. Consists, essentially, of a water reservoir having, preferably, a filtering material therein at its upper end and surmounted by a cover. At one side of this reservoir is attached an electrolytic purifying apparatus which may be removed without removing the cover or otherwise disturbing the filtering portion of the apparatus.

691,549. ELECTRIC ARC LAMP; S. H. Johnson, Stratford, Eng. App. filed July 29, 1901. The regulation of the lamp is effected by means of a thermal metallic strip through which the current passes. There is a main slip clutch on the movable carbon, a rest for disengaging the main clutch at the minimum limit of its range, a second slip clutch encircling the movable carbon, and means for tilting and tripping this clutch and allowing it only a limited motion.

691,557. HANDLE FOR MAKING AND BREAKING CIRCUITS; R. E. Leve, New York, N. Y. App. filed Nov. 14, 1901. A handle adapted to be connected with electric machines, such as cloth cutters, provided with a push-rod adapted to rotate an internal switch, step by step, one motion closing the circuit and the next opening it, to start and stop the machine respectively.

691,563. LAMP SOCKET FOR INCANDESCENT ELECTRIC LAMPS; A. McKenzie, Providence, R. I. App. filed April 29, 1901. Details.

691,587. PUNCHING REGISTER; C. Berst, New Albany, Ind. App. filed July 12, 1900. The invention relates to punching registers especially adapted for use in connection with fire-alarm and police telegraph systems. The object of the invention is mainly to provide, in connection with suitable escapement devices, gearing, a main-spring wheel and an electro magnet, a punch of simple and efficient character having a positive return movement.



691,667.—Synchronous Telegraph System.

691,600. MANUFACTURE OF ELECTRICAL CONDENSERS; J. Coates, Lynn, Mass. App. filed Jan. 2, 1901, renewed Aug. 9, 1901. (See Current News and Notes.)

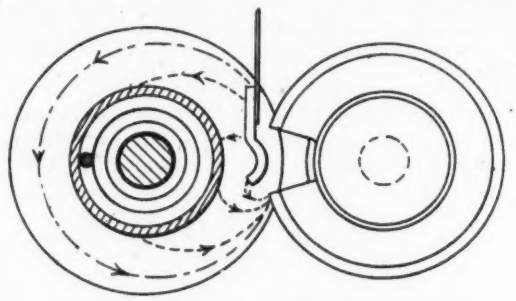
691,611. ELECTRIC BATTERY; A. De Dion and G. Bouton, Puteaux, France. App. filed Feb. 6, 1901. (See Current News and Notes.)

691,618. LOCKING DEVICE FOR MOTOR REVERSING SWITCHES; F. W. Garrett and E. W. Stull, Johnstown, Pa. App. filed June 28, 1901. The invention consists in the provision of co-operative locking members carried, respectively, by the regulating and reverse switches, the member carried by the reverse-switch having a fixed relation thereto and a corresponding number of locking positions, and the member carried by the regulating-switch having a movement independently thereof and so arranged and operated that it engages the first named member in such a manner as to lock the reversing-switch at all times except when the regulating-switch is at its off position.

691,664. TELEPHONE SYSTEM; G. Ritter, Stuttgart, Germany. App. filed Nov. 2, 1900. (See page 226.)

691,665. TELEPHONE SYSTEM; G. Ritter, Stuttgart, Germany. App. filed July 18, 1901. (See page 226.)

691,667. SYNCHRONOUS TELEGRAPH SYSTEM; H. A. Rowland, Baltimore, Md. App. filed Feb. 24, 1899. A plurality of condensers are arranged in circuit with the synchronizing devices, said condensers being alternately discharged through the synchronizing devices, to regulate their motion.



691,693.—Spark Interrupter.

691,675. MANUFACTURE OF ELECTRICAL CONDENSERS; E. Thomson, Swampscott, Mass. App. filed Jan. 2, 1901. (See Current News and Notes.)

691,683. AUTOMATIC ELECTRIC SIGNAL; F. E. Weinel, Apollo, Pa. App. filed March 26, 1901. A railway signal in which if an engine be reversed while in a block, the signals at the end of the block will be automatically changed.

691,692. CONTROLLING SYSTEM; T. Von Zweigbergk, Preston, England. App. filed July 8, 1901. Mechanism for operating a controller by means of compressed air governed electrically by one or more master controllers.

691,693. SPARK INTERRUPTER; T. Von Zweigbergk, Preston, England. App. filed Oct. 30, 1901. A spark interrupter in which the spark completely encircles the device and allows the interrupter to be placed directly in the sweep of the arc, a space which has heretofore been additional to the blow-out device.

11,961. MEANS FOR DRIVING DYNAMOS FROM CAR AXLES; J. L. Creveling, New York, N. Y. App. filed Sept. 23, 1901. The invention is designed to avoid the use of a pole changer in circuit with the dynamo, by compelling, through the employment of a single belt, the rotation of the armature in the same direction regardless of the direction of rotation of the car axle.

BOROUGHS OF MANHATTA
SHOWING TH
ELECTRIC SE
OF
THE NEW YORK

HUDSON

JERSEY CITY

HOBOKEN

RIVER

EAST

BOROUGH OF QUEENS

BOROUGH OF BROOKLYN

BOROUGH OF

Central Park

BLACKWELL'S ISLAND

EXPLANATION.

——— *General Service,- Light, Heat & Power,*

- - - - - - - - - *Series Service only,*

▬ *Stations and Annex Stations*

Corrected to Jan. 1st 1902.

MANHATTAN AND THE BRONX
SHOWING THE
ECTRIC SERVICE
OF

YORK EDISON CO.

EXTENSIONS TO RIVERDALE AND YONKERS

RIVER

HARLEM RIVER

HARLEM RIVER

HELL GATE

BRONX RIVER

BRONX PARK

CROTONA PARK

FORT GEORGE PARK

CLAREMONT PARK

COLUMBUS PARK

ST. MARY'S PARK

WALTON CEDAR PARK

RANDALL'S ISLAND

WARD'S ISLAND

Little Hell Gate

Hallet's Point Light

Throg's Neck

Ferry to Fort Lee

Riverside Park

Riverside Drive

Boulevard

Amsterdam Av.

Columbus Av.

Manhattan Av.

West End Av.

Broadway

Eighth Av.

Seventh Av.

Lenox Av.

Fifth Av.

Madison Av.

Park Av.

Lexington Av.

Third Av.

Second Av.

First Av.

Pleasant Av.

Lafayette Blvd.

Fort Washington Road

Kingsbridge Road

Bolton Road

Jumel Pl.

Edgecombe Road

Harlem River Driveway

Hamilton Pl.

St. Nicholas Pl.

St. Nicholas Ter.

St. Nicholas Av.

Bradhurst Av.

Convent Av.

Audubon Av.

Eleventh Av.

Ft. George Av.

Nagle Av.

Sherman Av.

Overlook Ter.

Cabrini Blvd.

Haven Av.

Wadsworth Av.

Trinity Cem.

Old Bowling Green

Polo Grounds

Base Ball Grounds

Riverside Church

Columbia University

Morningside Park

Mount Morris Park

Manhattan State Hospital

Lincoln Hospital

Metropolitan Museum of Art

Lenox Library

Public Library

Old Stone House

Old Dutch Church

Old Blockhouse

Old Fort

Old Mill

Old Windmill

Old Reservoir

Old Powder House

Old Cemetery

Old Tavern

Old Church

Old Academy

Old Mansion

Old Farm House

Old Barracks

Old Fort

Old Battery

Old Lighthouse

Old Ferry

Old Bridge

Old Dock

Old Wharf

Old Pier

Old Slip

Old Basin

Old Canal

Old Creek

Old Pond

Old Swamp

Old Meadow

Old Field

Old Orchard

Old Garden

Old Vineyard

Old Nursery

Old Greenhouse

Old Conservatory

Old Library

Old Museum

Old Theatre

Old Opera House

Old Concert Hall

Old Ballroom

Old Dance Hall

Old Skating Rink

Old Bowling Alley

Old Billiard Room

Old Gymnasium

Old Swimming Pool

Old Bathhouse

Old Laundry

Old Dry Cleaning

Old Tailor Shop

Old Barber Shop

Old Beauty Parlor

Old Shoe Repair

Old Watch Repair

Old Jewelry Store

Old Pawnshop

Old Bank

Old Insurance Office

Old Real Estate Office

Old Law Office

Old Doctor's Office

Old Dentist's Office

Old Veterinary Hospital

Old Pet Shop

Old Florist

Old Seed Store

Old Hardware Store

Old Paint Store

Old Glass Store

Old Lumber Yard

Old Coal Yard

Old Ice House

Old Gas Works

Old Electric Plant

Old Power House

Old Water Tower

Old Fire Station

Old Police Station

Old Post Office

Old Courthouse

Old Jail

Old Prison

Old Asylum

Old Hospital

Old Dispensary

Old Clinic

Old Nursing Home

Old Orphanage

Old Home for the Aged

Old Cemetery

Old Crematory

Old Mausoleum

Old Monument

Old Statue

Old Fountain

Old Clock Tower

Old Bell Tower

Old Observatory

Old Planetarium

Old Aquarium

Old Zoo

Old Botanical Garden

Old Arboretum

Old Park

Old Playground

Old Athletic Field

Old Stadium

Old Racetrack

Old Golf Course

Old Tennis Court

Old Swimming Pool

Old Bathhouse

Old Boathouse

Old Yacht Club

Old Rowing Club

Old Sailing Club

Old Fishing Club

Old Hunting Club

Old Gun Club

Old Rifle Club

Old Archery Club

Old Polo Club

Old Cricket Club

Old Baseball Club

Old Football Club

Old Basketball Club

Old Volleyball Club

Old Handball Court

Old Squash Court

Old Racquetball Court

Old Bowling Alley

Old Billiard Room

Old Gymnasium

Old Swimming Pool

Old Bathhouse

Old Laundry

Old Dry Cleaning

Old Tailor Shop

Old Barber Shop

Old Beauty Parlor

Old Shoe Repair

Old Watch Repair

Old Jewelry Store

Old Pawnshop

Old Bank

Old Insurance Office

Old Real Estate Office

Old Law Office

Old Doctor's Office

Old Dentist's Office

Old Veterinary Hospital

Old Pet Shop

Old Florist

Old Seed Store

Old Hardware Store

Old Paint Store

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